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THESIS

OPTIMIZING HF ANTENNA SYSTEMS
ON THE DOLPHIN AND SEA HAWK HELICOPTERS

by

James B. Crawford

September 1987

Thesis Advisor

R.W. Adler

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Optimizing HF Antenna Systems
on the Dolphin and Sea Hawk Helicopters

by

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Making an aircraft available and modifying it to test various antenna systems and configurations is extremely costly. The computer model is an excellent alternative means of analyzing antenna systems for optimum communication system performance. In this study electromagnetic "wire grid" computer models of two helicopters and eight HF antenna configurations are developed using Interactive Graphics Utility for Automated NEC Analysis (IGUANA). Numerical Electromagnetics Code (NEC) is used to obtain radiation patterns, and the Advanced Prophet program is used to develop the criteria for judging system effectiveness. These computer results compare favorably with test range data, showing great savings of cost. They provide the additional advantage of showing radiation patterns at an elevated angle for skywave propagation analysis (patterns which cannot be obtained on an antenna test range).

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I. INTRODUCTION

A. NEED FOR THE STUDY

The Coast Guard relies heavily on helicopters to perform its primary missions of enforcement of laws & treaties, search and rescue, aids to navigation, and maritime defense. Two types of helicopters are used in the Coast Guard. The medium-range recovery (MRR) helicopter is the HH-3F Pelican which will be replaced shortly by the HH-60J Sea Hawk. The transition from the HH-52A Guardian to the HH-65A Dolphin is almost complete. The Dolphin is the Coast Guard's short-range recovery (SRR) helicopter. In executing their assigned missions both the MRR and SRR routinely operate from the coast line out to 200 nautical miles off shore and remain below 1000 feet for most of the mission. It is essential for the helicopters to maintain effective communications with a Coast Guard communication station to exchange operational information and receive direction as well as for flight following.

B. STATEMENT OF THE PROBLEM

The Dolphin was designed to use a Rockwell-Collins 718U-5 HF radio transceiver and a long-wire antenna to provide reliable two-way voice communications at ranges

of up to 200 nautical miles. Figure 1, taken from the HH-65A flight handbook, illustrates how the long-wire antenna runs along the tail boom and up the vertical tail on the starboard side, through a non-metallic transition tube, and doubles back along the port side of the helicopter. During development flight tests the operational performance of this system was found to be marginal at best. Shortly after accepting the Dolphin for operational use several aircraft experienced structural failures of the long-wire resulting in wire ingestion into the fenestron. Consequently, the long-wire was shortened to exclude the portion along the vertical tail. This modified antenna exacerbated the performance problems of the Dolphin's HF system.

The MRR replacement helicopter, the Sea Hawk, was reported to have similarly poor HF operational performance and the Navy has zeroed in on the long-wire antenna as the chief cause of the problem. [Ref. 1]

C. PREVIOUS WORK

Tests were recently conducted at the Naval Air Test Center, Naval Air Station, Patuxent River, Maryland, to determine the operating performance of the HF long-wire antenna installations on both the Dolphin and the Sea Hawk. Similar tests were conducted with a Rockwell-Collins 437R-2 tuned HF monopole antenna system installed

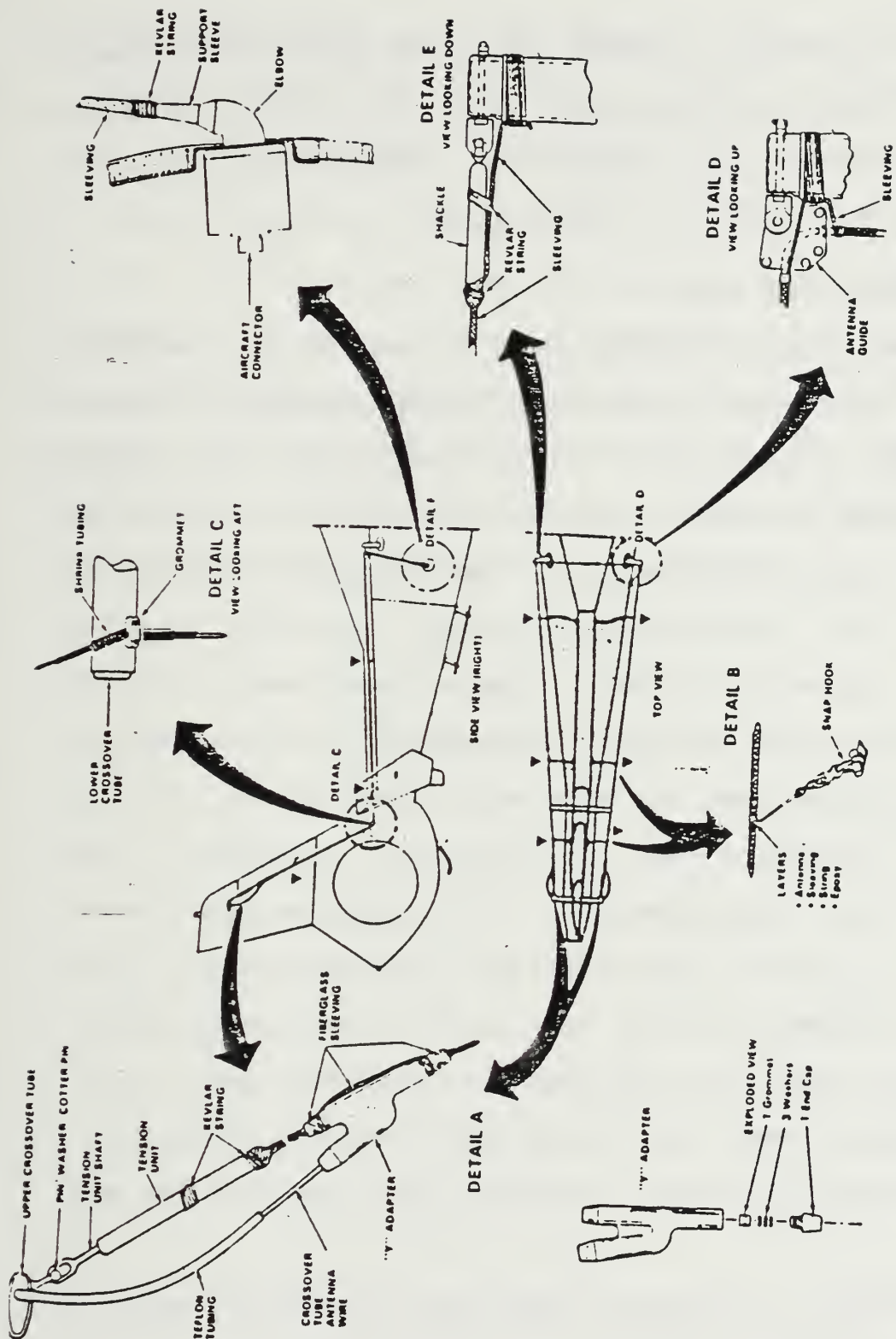


Figure 1 Dolphin Long-wire Antenna Configuration.

on each helicopter. Comparison of radiation patterns in the horizontal plane showed that the tuned monopole system improved HF performance, particularly in the vertical polarization. [Refs. 1, 2]

D. SCOPE OF THE THESIS

Actual aircraft modification to test various antenna systems and configurations has proved extremely costly and time consuming. In this thesis study computer modeling was used as an alternative method for testing HF antenna system performance. The Interactive Graphics Utility for Automated NEC Analysis (IGUANA) computer program, prepared for NOSC by System Development Corporation, was used to develop electromagnetic computer models for the Dolphin and Sea Hawk helicopters as well as for various configurations of long-wire, monopole, and shorted-loop type antennas. These computer models were used as input for the Numerical Electromagnetics Code (NEC), a computer program developed at Lawrence Livermore Laboratory under the sponsorship of the Naval Ocean Systems Center (NOSC) and the Air Force Weapons Laboratory. Radiation patterns were obtained as the output of the NEC runs.

Typically, an antenna range can conveniently measure radiation patterns only in a plane which is nearly horizontal. Since ground waves over the ocean rarely

propagate more than 100 to 150 nautical miles at best, communication in the HF range frequently requires the use of sky wave propagation. It would be helpful to be able to obtain radiation patterns at any angle above the horizon. The engineer would then have more complete information on which to base a comparative decision on the ground wave/sky wave performance of various antenna systems. The computer models developed in this thesis, combined with the NEC code provide a convenient mechanism to obtain radiation patterns in any direction.

II. SKY WAVE PROPAGATION

Sky wave propagation occurs when a signal is "reflected" or bent in the ionosphere.

A. NATURE OF THE IONOSPHERE

The ionosphere is an ionized region in the upper atmosphere extending from about 60 to 300 kilometers. The portion of the ionosphere which is used for HF propagation is broken down into three regions -- D, E, and F -- with electron density increasing and neutral atmospheric constituents decreasing with altitude. The amount of bending or reflection experienced by a signal in the ionized layers is dependent on frequency. Higher frequency signals are bent to a lesser degree than lower frequency signals and therefore penetrate farther into the ionosphere. There is a certain critical frequency which, if exceeded, allows the signal to escape into space before being sufficiently bent to return to earth. So, for effective sky wave communications, a frequency must be utilized which is lower than the critical frequency.

On the other hand, losses are greater at the lower frequencies due to energy absorption as a result of

setting the ionized particles into motion. Because of the high ratio of neutral to ion particles in the lower ionosphere, an electron passing through this region is more likely to collide with a neutral particle and consequently be unable to re-couple all of its energy back into the wave. By completing its reflection in the lower levels of the ionosphere, the lower frequency signal spends comparatively more time in a region with high neutral particle densities. Higher frequency signals pass more quickly through these high-loss regions and are turned back toward the earth with less overall losses. [Refs. 3, 4]

B. PROPAGATION VIA THE IONOSPHERE

A compromise must be established where the frequency is low enough to permit the signal to be returned to earth but high enough so that all useful energy is not absorbed enroute to the receiving station. The lowest usable frequency is termed the LUF, while the maximum usable frequency is termed the MUF. The best compromise frequency, as described above, is termed the FOT, or Frequency of Optimum Transmission. The FOT is considered to be approximately 80% of the MUF. In fact, deviation away from the FOT results in extra losses which significantly reduce system performance when communicating via sky wave. John Brune of the Army's NOE

Communications Branch at Ft. Monmouth, NJ, compiled data which shows that deviating ± 1.5 MHz from FOT in the early morning hours produces 20 dB "extra expected" loss. The mid-day period is only slightly more forgiving where a deviation of ± 2 MHz produces the extra 20 dB loss. A loss of 20 dB equates to one one-hundredth effectiveness. Mr. Brune points out correctly that for a successful sky wave communications link it is advisable to give more attention to choice of frequency rather than increase of transmitter power. [Ref. 5]

The elevation angle of the transmitted signal is another important factor in sky wave propagation. As shown in Figure 2, transmitted rays entering the ionized region at angles above the critical angle for that frequency are not bent enough to be returned to earth. Rays entering at angles below the critical angle are returned to earth at increasingly greater distances as the angle approaches the horizontal. It is clear that there is a certain distance along the earth's surface where little or no signal energy will be found. This area, called the skip zone, is too far away from the transmitter for effective ground wave coverage, and too close for sky wave coverage.

It seems at first glance that the skip zone would be easy to predict. The critical ray angle for a given

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DATE: 1/1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES
 PREP: 9.0 SSN: 59.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 QMIR: HELO2 36-0-0 N 72-30-0 W ANT: 0 0 WOMNIX PWR: 100.00
 QCUR: NEOLK 36-40-12 N 76-31-48 W ANT: 182 0 WOMNIX RANGE: 198.9 NMI
 IONOSPHERE: FOF2= 3.9 MHZ FOF1= 4.2 MHZ FOF3= 8.6
 HMF2= 341. KM VME2=119.3 KM

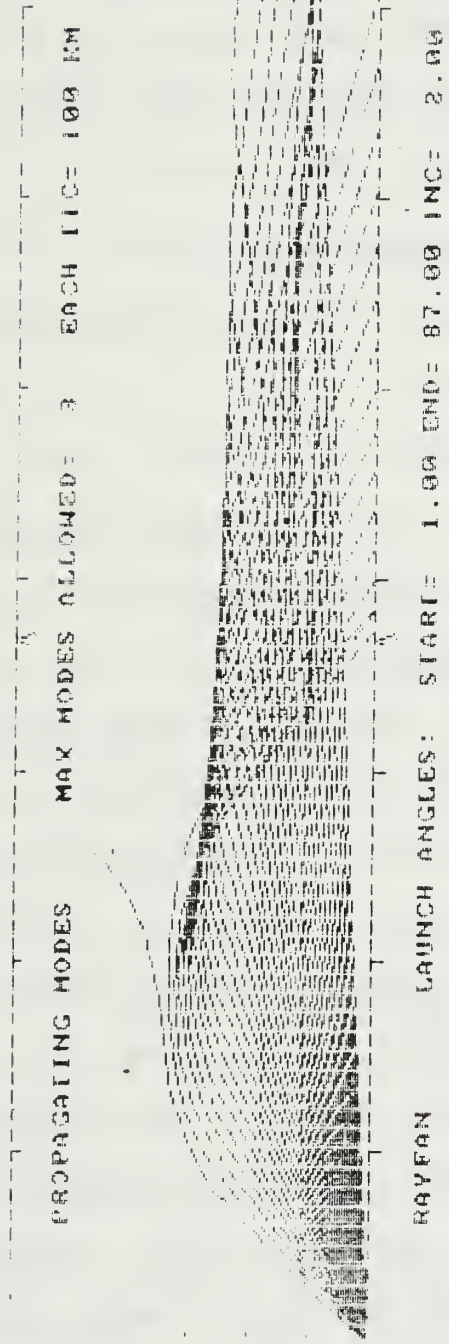


Figure 2 Advanced Prophet Critical Ray Angle.

frequency, however, is a complicated function of ionization density and layer height. The ionization of the atmosphere is believed to be caused by ultraviolet radiation from the sun. The degree of ionization of a layer is dependent upon time of day, season, and sun spot activity. [Refs. 3,4,6]

c. COMPUTER SIMULATION

Several computer programs are available to predict propagation via the ionosphere but Advanced Prophet, distributed by Naval Ocean Systems Center, is used herein. It is compatible with the Coast Guard Standard Terminal and provides all the required features necessary for this study.

The Advanced Prophet program was used in a scenario where a ground station at Norfolk, Virginia, was communicating with four helicopters engaged in typical Coast Guard missions. The range to helo 1 was 100 nautical miles (nm) and to helo 2 was 200 nm. Helo 3 was introduced only once to compare its horizontally polarized signal's ground wave range with that of the vertically polarized signal of helo 2. Helo 4 had the closest range at 50 nm. The helicopters were operated at 1000 feet above the ocean, the wind was programmed to be 25 knots, and the sun spot number was set at an average value of 50. The noise models were engaged and the

transmission mode was selected to be single side-band. The ground station used a vertically polarized antenna while the helos (except helo 3) were assumed to radiate isotropic signals. Summer and winter seasons were investigated as well as daytime and nighttime ionospheric conditions. The complete results of the simulation have been included in Appendix B, and certain figures from the study have been used to illustrate points in this section.

D. EFFECTIVE COMMUNICATION

The goal of effective communication from zero to 200 nm range is met by eliminating transmitting station's skip zone (Figure 3). This may be accomplished by increasing the area of ground wave coverage and by increasing the critical ray angle to bring the limit of sky wave coverage closer to the transmitter.

As illustrated in Figures 4 and 5 and explained in Reference 8, page 9-4, effective ground wave propagation over the ocean beyond 10 nm range is made possible by use of vertically polarized signals. An efficient Coast Guard helicopter's antenna system should produce a high gain, uniformly distributed, vertically polarized radiation pattern in the horizontal plane. Figure 4 shows that frequency selection is also very important in

1. *Chlorophyll a* (Chl *a*)

[illegible]

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[illegible]

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Figure 3 Advanced Prophet Area Coverage.

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GROUNDWAVE ANALYSIS FOR DATE: 7/ 1/86 TIME: 18:00 UT
 XMTR: HELO2 POLARIZATION: V POWER: 100.000 WATTS
 RCVR: NEOLK FREQUENCY: 5.696 MHZ RANGE: 198.9 NMI
 ANTENNA HEIGHT XMTR: 500.0 FEET RCVR: .8 FEET
 TERRAIN: SE COVER: // WIND: 25.0 KNOTS ATMOSPHERIC NOISE: YES
 DIELECTRIC: 81.0 SURFACE CONDUCTIVITY: .40E+01 MUO/M
 READ SNR: 12.0 DB BANDWIDTH: 2.800 KHZ MANMADE NOISE: SH

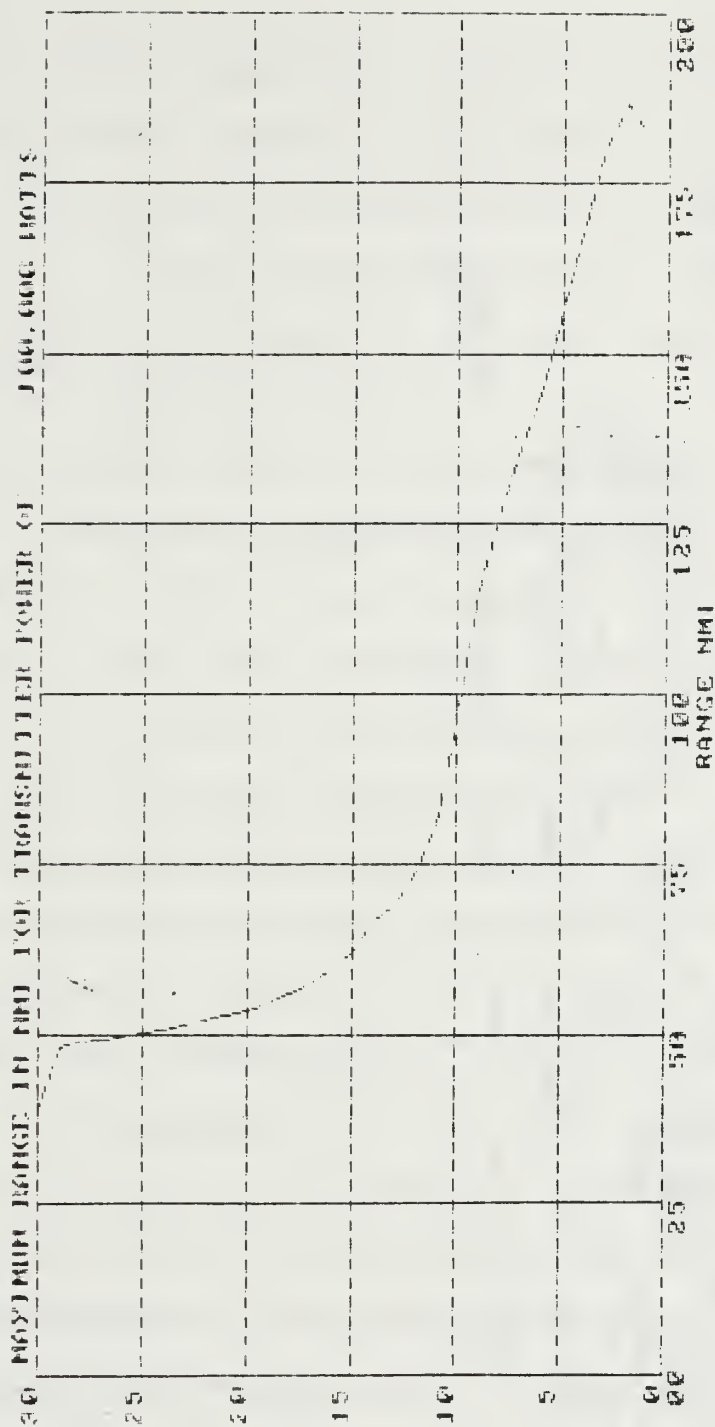


Figure 4 Ground Wave Range vs. Frequency,
 Vertically Polarized Signal.

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GROUNDWAVE ANALYSIS FOR DATE: 7/1/86 TIME: 18:00 UT
 XMITR: HEL03 POLARIZATION: H POWER: 100.000 WATTS
 RCVR: NEOLK FREQUENCY: 5.696 MHZ RANGE: 198.9 NMI
 ANTENNA HEIGHT XMITR: 500.0 FEET RCVR: .0 FEET
 TERRAIN: SE COVER: // WIND: 25.0 KNOTS ATMOSPHERIC NOISE: YES
 DIELECTRIC: 81.0 SURFACE CONDUCTIVITY: .000101 MUOM
 RECD SNR: 12.0 DB BANDWIDTH: 2.800 KHZ MANMADE NOISE: SH

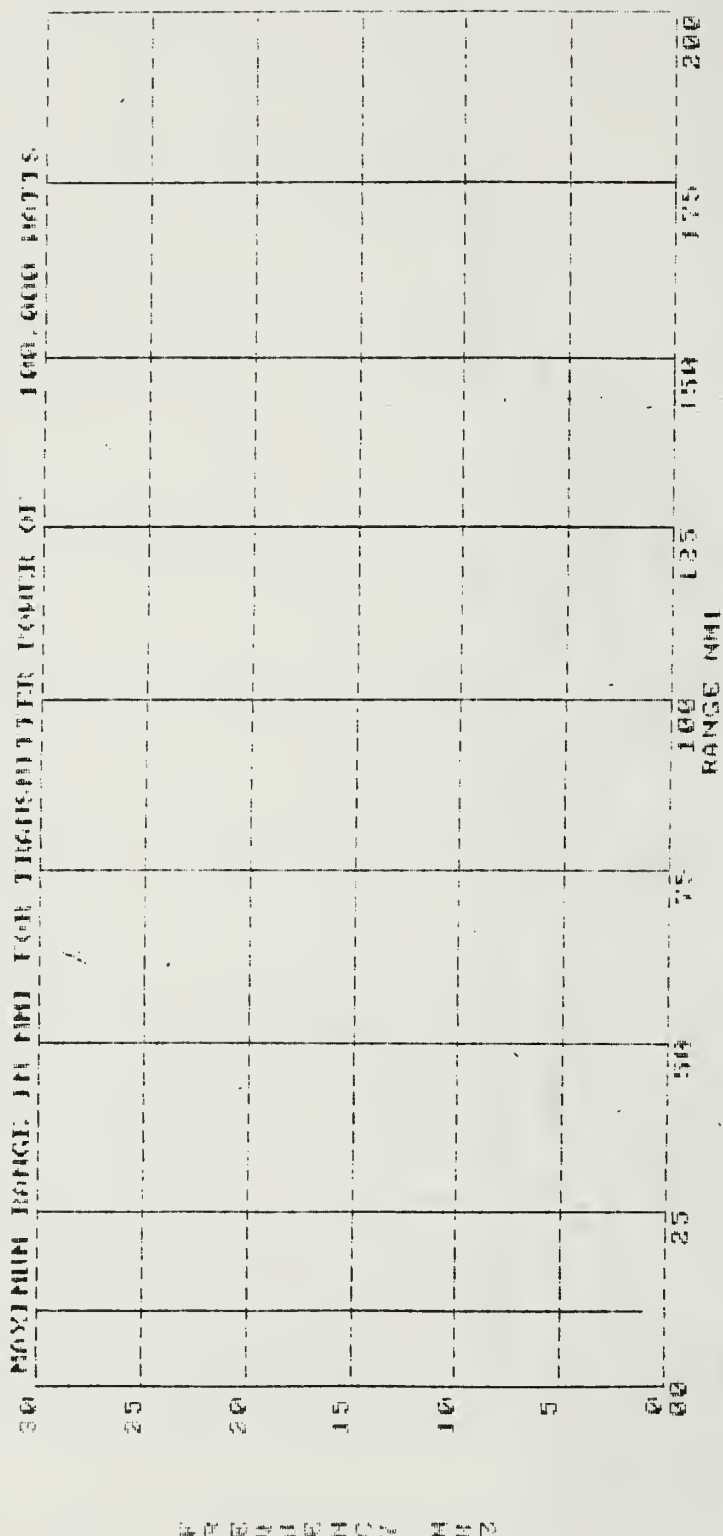


Figure 5 Ground Wave Range vs. Frequency,
 Horizontally Polarized Signal.

maximizing ground wave propagation. In general, lower frequencies yield greater ground wave coverage.

Increasing the critical ray angle is done by proper frequency selection. Since optimum frequency is tied to a dynamic ionosphere, propagation programs such as Advanced Prophet are essential tools.

The Advanced Prophet scenario illustrated that helo 4, at 50 nm, essentially always communicated via ground wave. Helos 1 and 2 would generally utilize sky wave propagation and the frequency "windows" for effective communication were seen to be from about 3 to 9 MHz depending on time of day and other solar conditions. Their ray angles as determined by the Prophet program ranged from 45 to 76 degrees with an average angle of about 64 degrees above the horizon.

Signals which are transmitted at large elevation angles are said to be propagating in the Near Vertical Incidence Skywave mode (NVIS). The average of 64 degrees may be taken as the optimum launch angle for 100 to 200 nm one hop NVIS propagation. With this average figure in mind an antenna system can be designed to produce maximum gain and a uniformly distributed radiation pattern at the optimum elevation angle. Polarization of the vertically radiated signal is not important since the effects of reflection from the ionosphere tend to produce random

polarization in sky wave signals [Refs. 6, 7]. Consequently, only the total radiation pattern is of concern for sky wave propagation.

III. MODELING

A. NUMERICAL ELECTROMAGNETICS CODE (NEC)

The Numerical Electromagnetics Code (NEC) is a FORTRAN computer program which is used to analyze the electromagnetic response of metal structures. Antennas, wires, masts, surfaces, or virtually any other metal structure may be modeled and analyzed using NEC. Structures may be modeled in free space or over a ground plane. While it is possible to push the code beyond its limits careful modeling and analysis with NEC provides accurate results from 2 MHZ through 25 GHZ [Ref. 8, 9]. NEC requires a main-frame computer, but a smaller micro-computer based version of the code called MININEC is also available.

The code performs a numerical solution of integral equations for currents induced on the structure using a form of Method of Moments for "point matching" at each wire segment center. Kirchoff's Current Law is enforced on segments at wire junctions to reduce the linear equations to a manageable number which are then solved by the Gauss-Doolittle method.

Once the current on each segment is known, the radiation patterns are obtained by numerical integration

of the RF current distribution on the model. Output is in tabular form, easily accessible for processing with graphical routines.

Excellent detailed descriptions of the NEC code are found in References 8, 10 and 11.

B. INTERACTIVE GRAPHICS UTILITY FOR AUTOMATED NEC ANALYSIS (IGUANA)

NEC requires input geometry cards for each wire in the model. Every card must include the coordinates in three-space of both end points as well as the wire radius and segmentation. Developing this type of model accurately is a lengthy, tedious, and error prone process. The data must be checked and re-checked to ensure measurement and keyboard errors are not present in the model. IGUANA is a user-friendly micro-computer based program which provides a partially automated system for both data entry and display. Its use greatly reduces the time and effort required for accurate model development.

Data entry begins by using a digitizer to enter lines from a two-view scale drawing. The program converts this data into a three-dimensional wire model and displays the entire structure graphically. The program has the capability of rotating the displayed structure and of magnifying selected portions (zooming). The user can

edit the displayed structure via mouse, adding or removing wires and points as desired. When the model is completed the program will generate the required geometry data cards in NEC format. Utilities which include optional prompts are available within IGUANA to create or edit the NEC comment, geometry, or program control cards. [Ref. 12]

C. DOLPHIN MODEL

The Coast Guard's SRR helicopter, the HH-65A Dolphin, was modeled as an equivalent grid of wires. The use of wire grid models for complex bodies has been well documented [Ref. 8, 13]. Some concern existed for this case, however, because of the high level of composite materials in the make-up of this aircraft. The vertical fin was almost all carbon fiber composite material, while the tail cone panels consisted of an inner and outer metal skin with a nomex honeycomb material sandwiched between them. The individual panels were electrically insulated from one another for corrosion prevention purposes (Figure 6). Except for the vertical tail, fins, and horizontal stabilizer, the wire model was constructed as though this was a standard metal helicopter in the belief that, at RF, the framework would have appeared solid. The vertical tail, fins, and horizontal

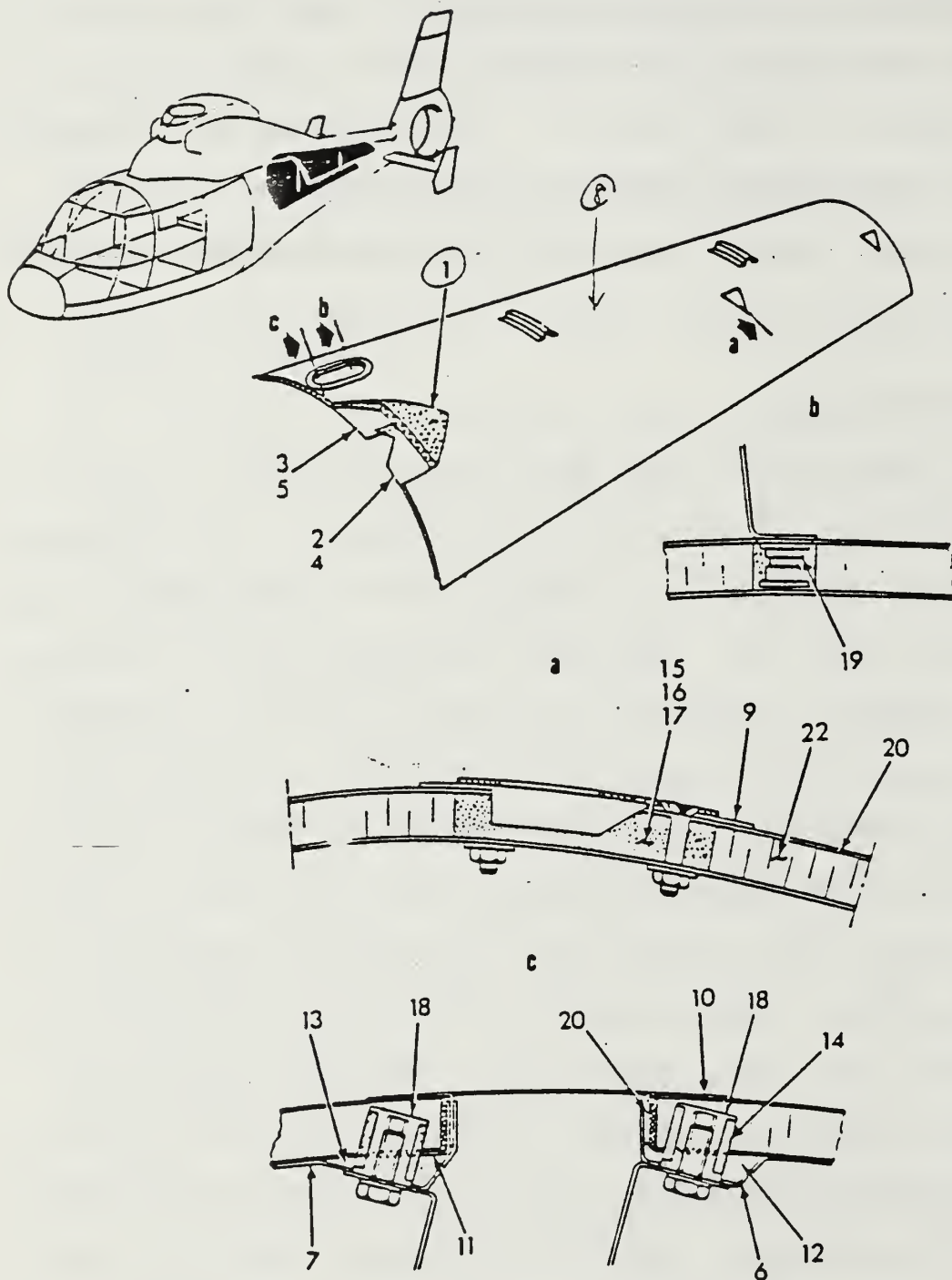


Figure 6 Dolphin Skin Panels.

stabilizer were modeled with a coarser wire grid because of their highly composite makeup.

A simple wire antenna model was developed to simulate each of four HF antenna systems contemplated for use on the Dolphin. These were:

1. The original long-wire antenna (Fig. 7,8)
2. The Collins 437R-2 tuned monopole antenna (Fig. 9,10)
3. The tube or transmission line antenna (Fig. 11,12)
4. The long shunted loop antenna (Fig. 13,14)

Restrictions on segment lengths and wire radii in terms of wave length (frequency) were delineated in Reference 11. The frequencies investigated varied from 3 to 18 MHz, so a convenient wire radius seemed to be one inch (.0254m), while nominal segment length was .5 meters. Prior experience indicated that segments near the excitation point needed to be kept as small as possible for an accurate model of the feed region [Ref. 8], and so, consistent with the restrictions of Reference 11, the segment lengths on the antenna models were minimized.

D. SEA HAWK MODEL

The initial geometry data cards for the HH-60J Sea Hawk, the Coast Guard's MRR helicopter, were obtained from ESL, a division of TRW. Since this Sea Hawk model was developed without the benefit of the IGUANA program

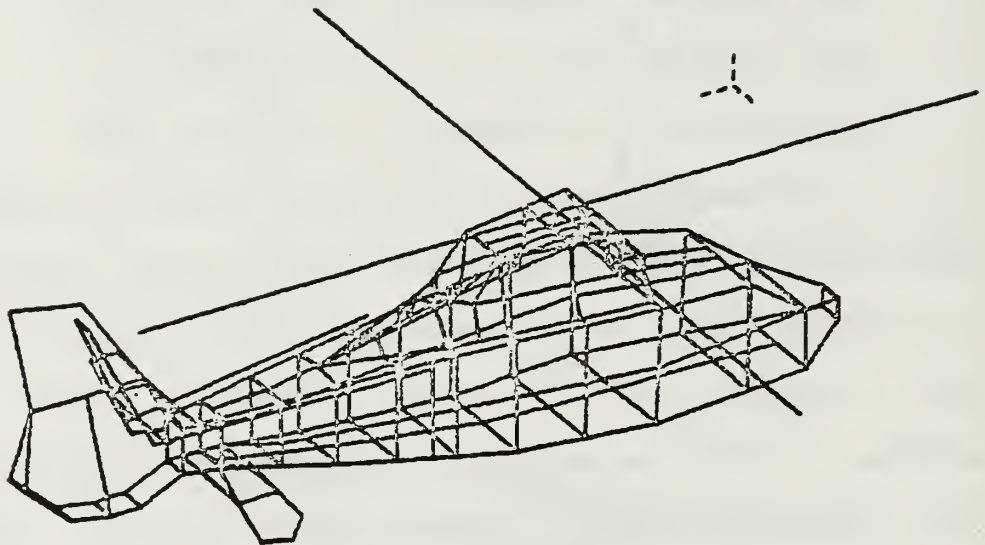


Figure 7 Dolphin Model with Long-wire.

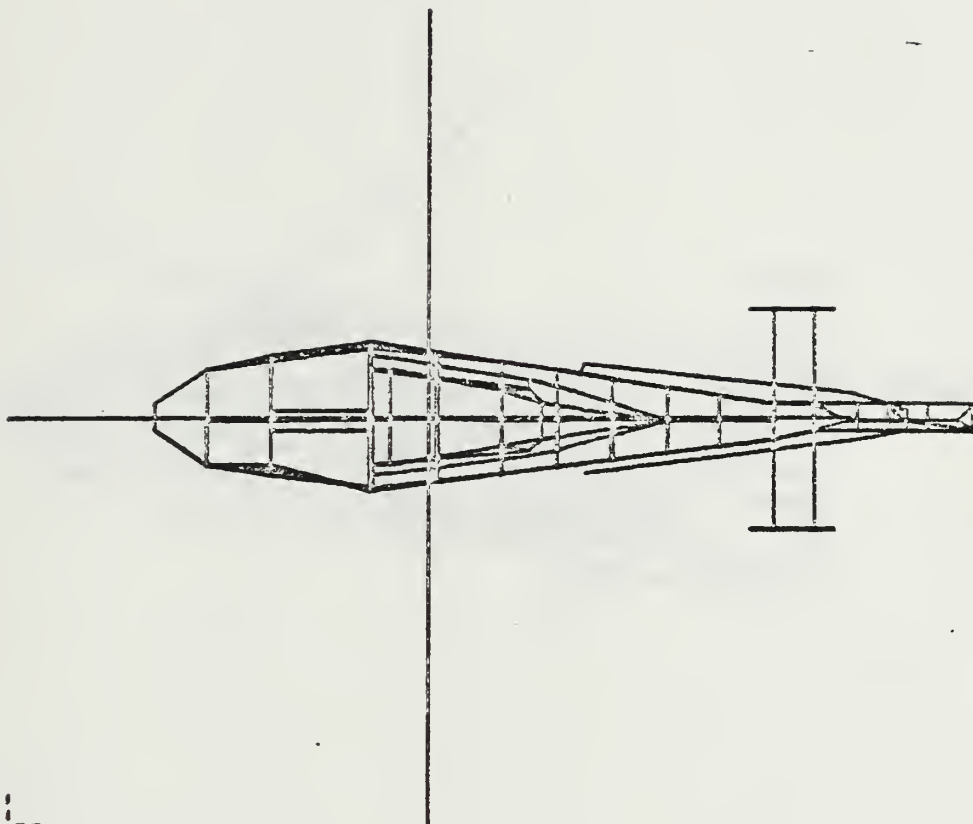


Figure 8 Dolphin Model with Long-wire, Top View.

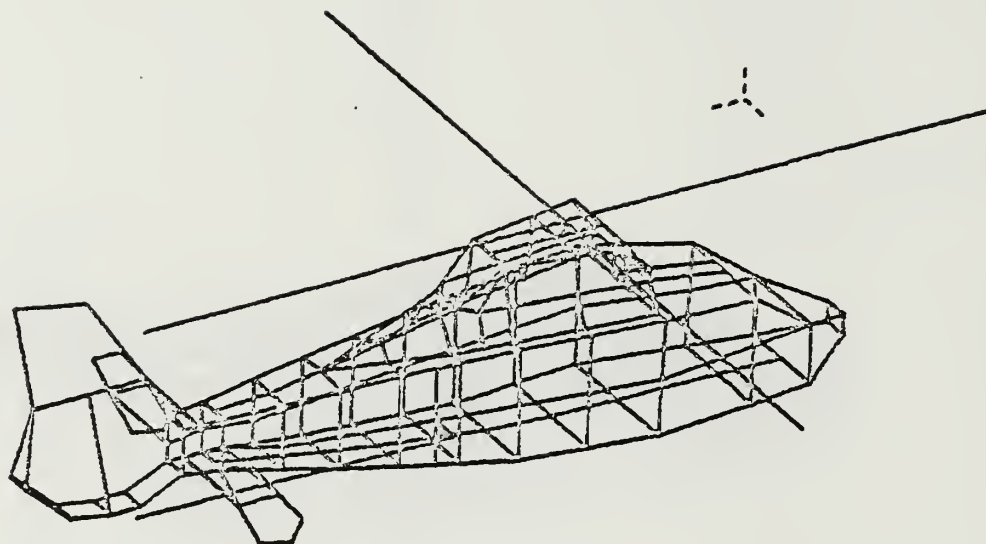


Figure 9 Dolphin Model with Tuned Monopole.

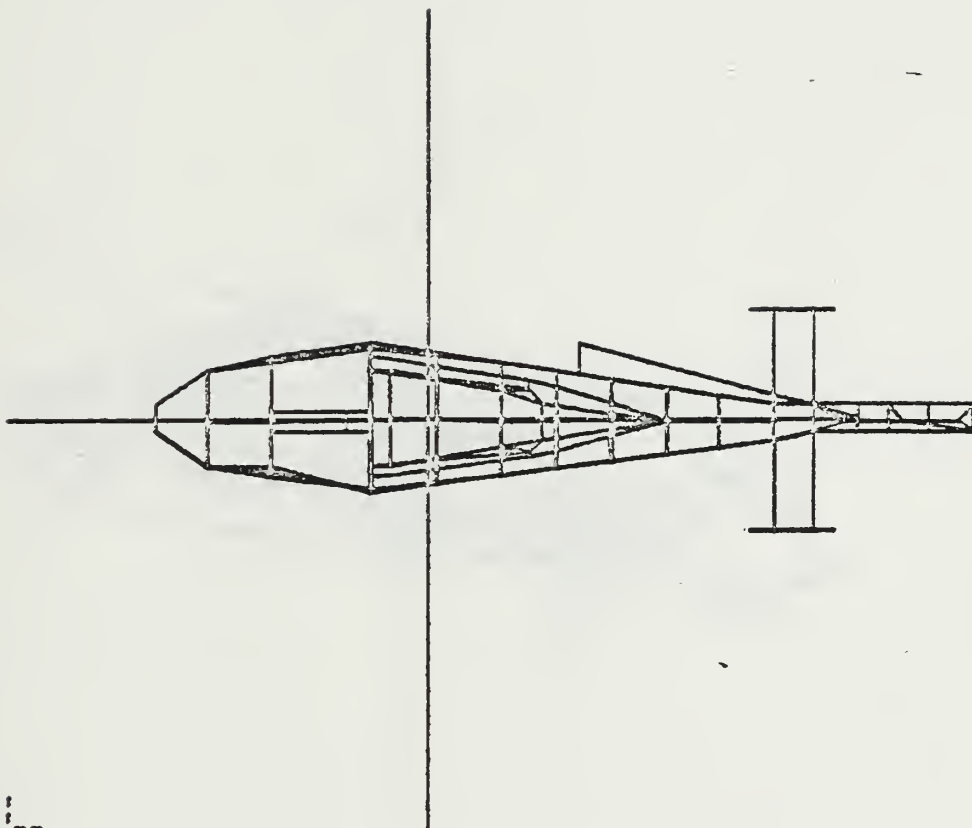


Figure 10 Dolphin Model with Tuned Monopole,
Top View.

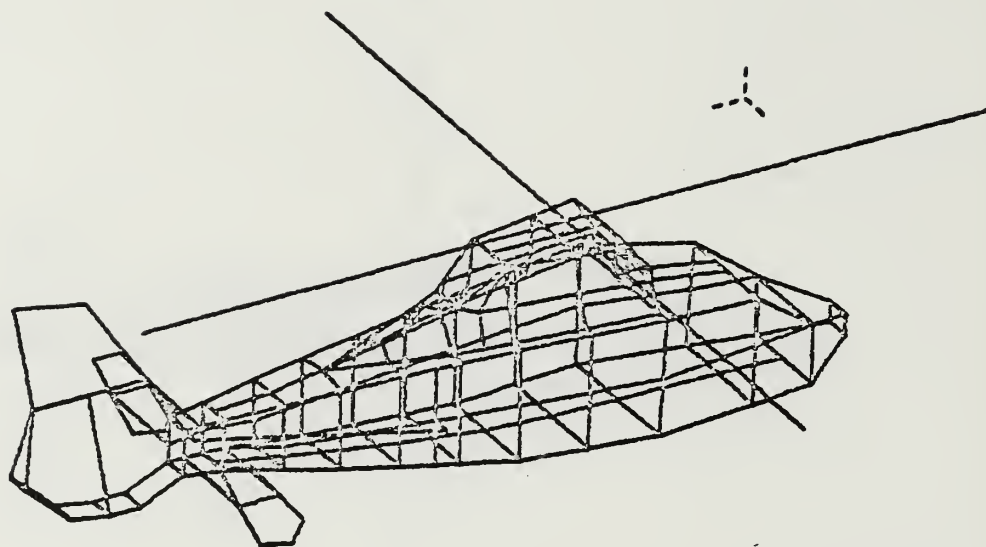


Figure 11 Dolphin Model with Transmission Line.

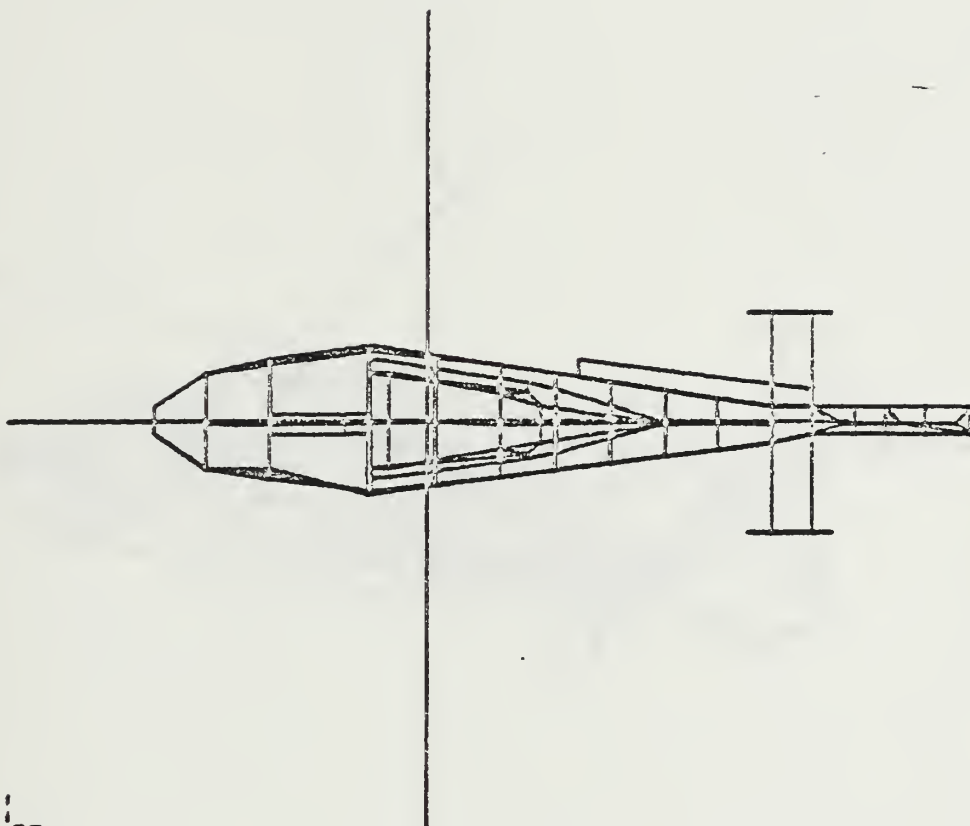


Figure 12 Dolphin Model with Transmission Line,
Top View.

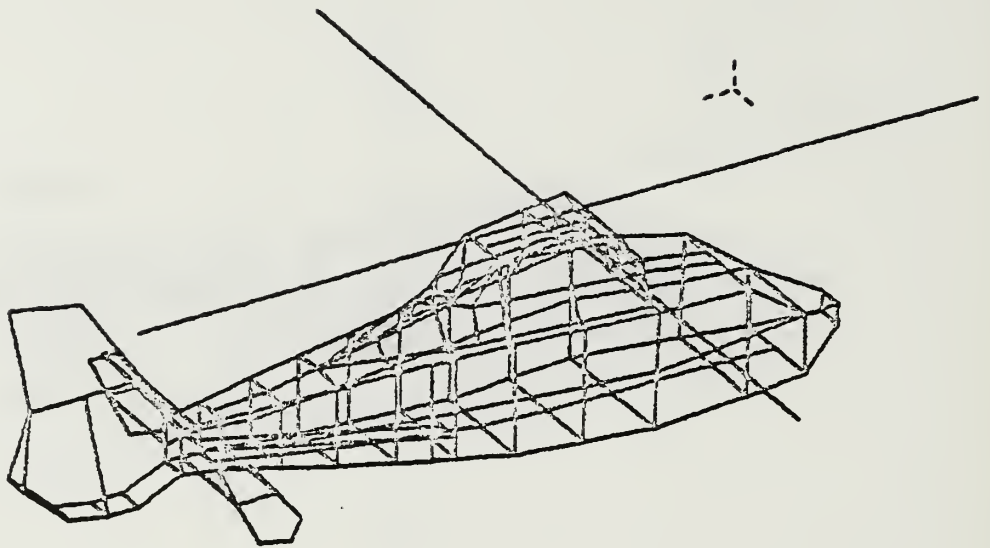


Figure 13 Dolphin Model with Long Shunted Loop.

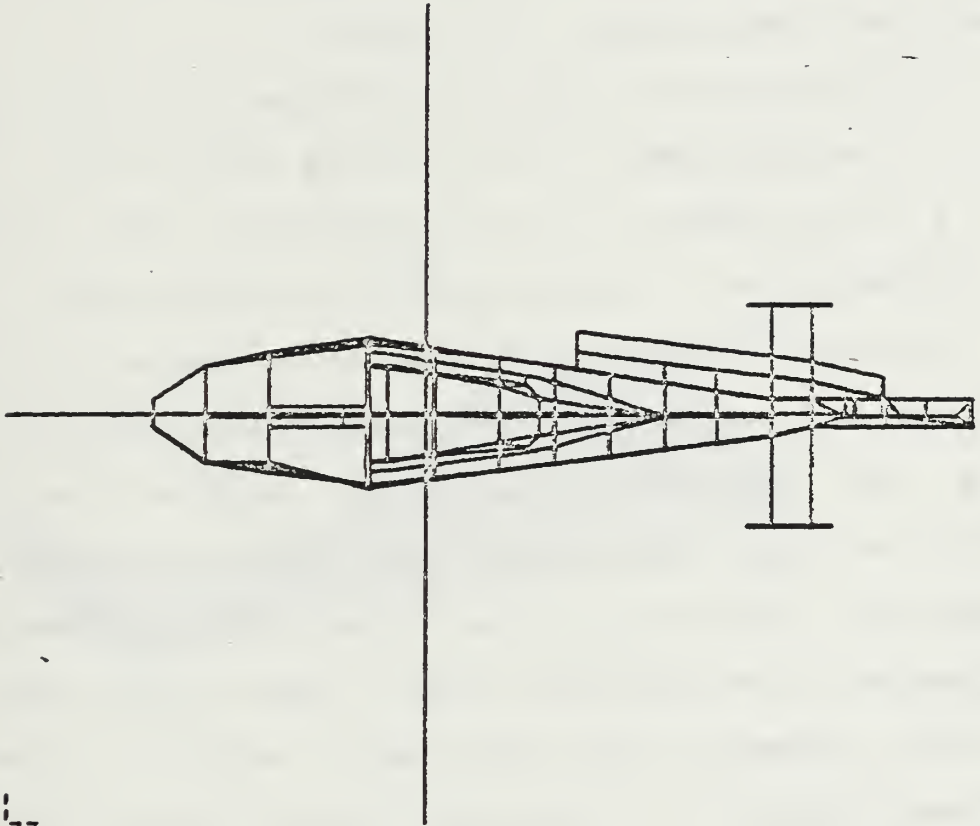


Figure 14 Dolphin Model with Long Shunted Loop,
Top View.

it tended to be a bit less complex than the Dolphin model. The data cards were input into IGUANA and the geometry was modified to include a horizontal stabilizer and a more dense vertical tail.

Similarly, wire models were developed for each of the Sea Hawk's HF antennas. They were:

1. The original long-wire configuration (Fig. 15,16)
2. Navy placement of the Collins 437R-2 (Fig. 17,18)
3. CG placement of the Collins 437R-2 (Fig. 19,20)
4. The tube or transmission line antenna (Fig. 21,22)

When the Sea Hawk model was run at frequencies below 13 MHz with the original long-wire antenna model attached the code was unable to model the currents accurately. Negative input impedance and negative radiated power were observed. Initially, it was thought that shortening the segments on the helicopter body to more closely match the antenna segment length would help, but this correction proved ineffective. Large wire radius jumps at junctions have been known to cause the same problem [Refs. 8, 14], but all wires in this model were equal in radius. Finally it was noted by G. J. Burke that the NEC code has some limitations in modeling electrically small antennas in the vicinity of loops [Ref. 15]. In this case the loops were formed by the wire grid making up the helicopter body. The loop currents at low frequencies

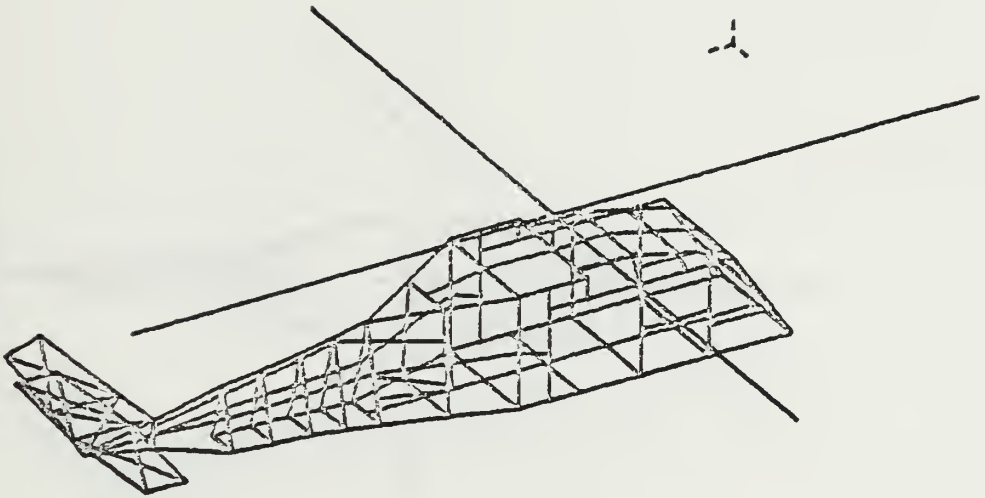


Figure 15 Sea Hawk Model with Long-wire.

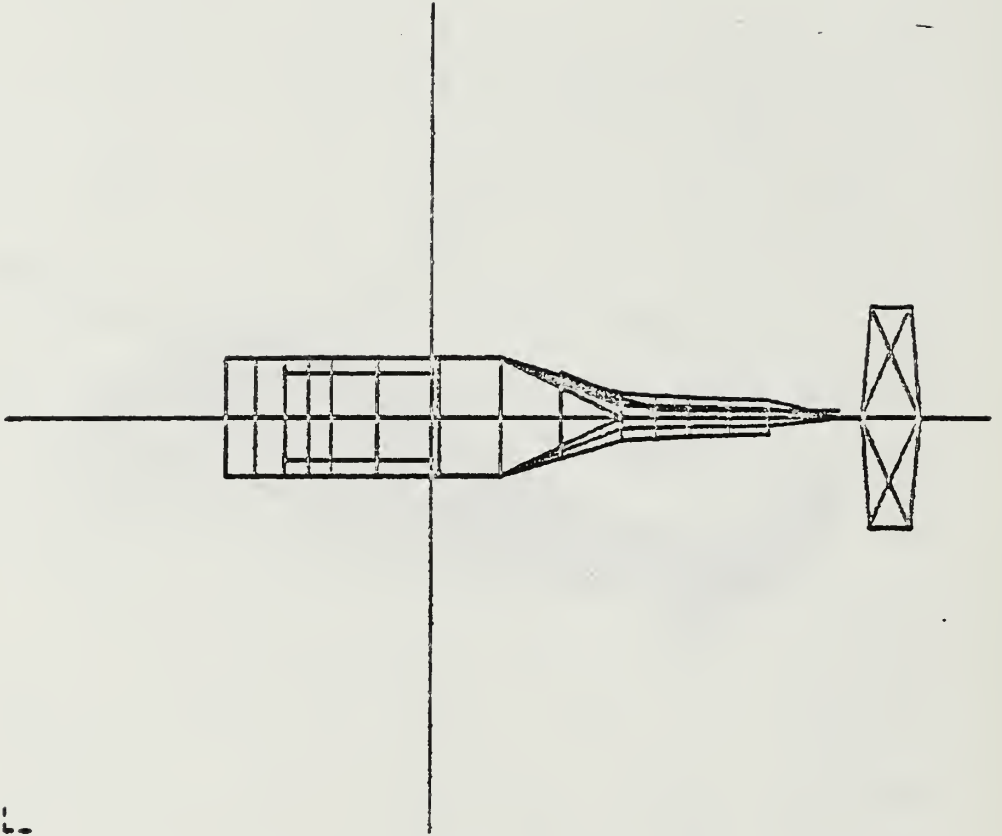


Figure 16 Sea Hawk Model with Long-wire, Top View.

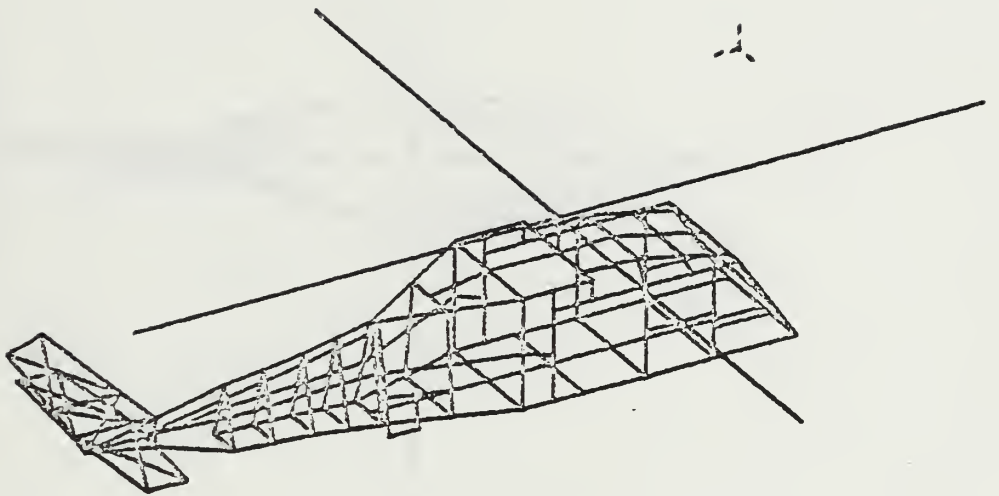


Figure 17 Sea Hawk Model with Navy Tuned Monopole.

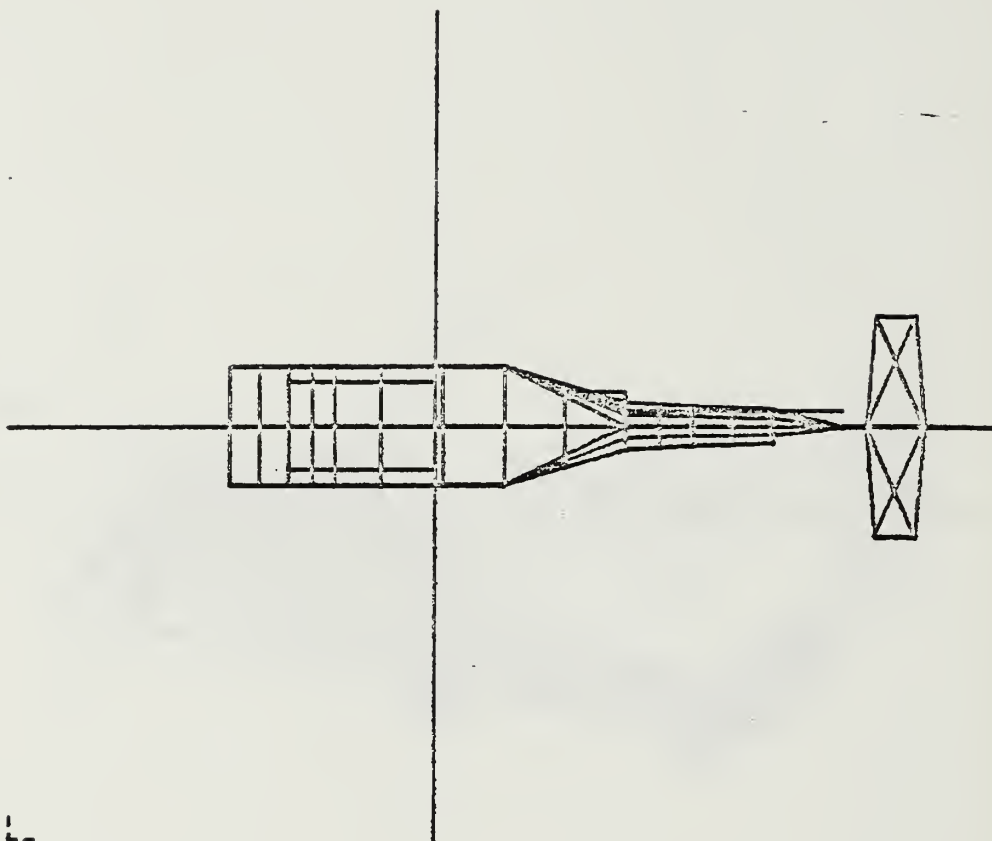


Figure 18 Sea Hawk Model with Navy Tuned Monopole,
Top View.

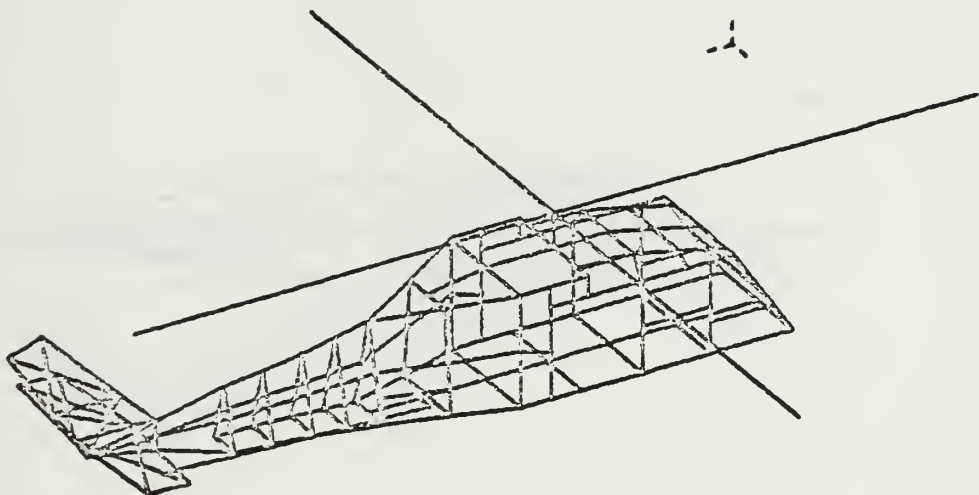


Figure 19 Sea Hawk Model with CG Tuned Monopole.

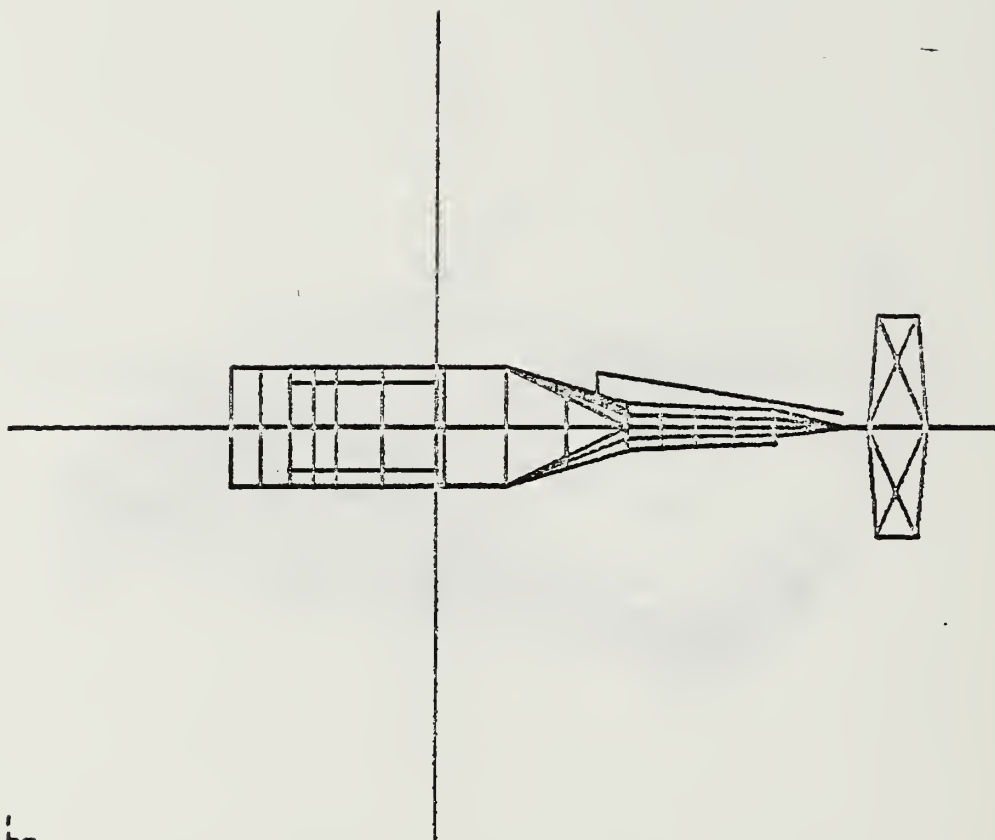


Figure 20 Sea Hawk Model with CG Tuned Monopole,
Top View.

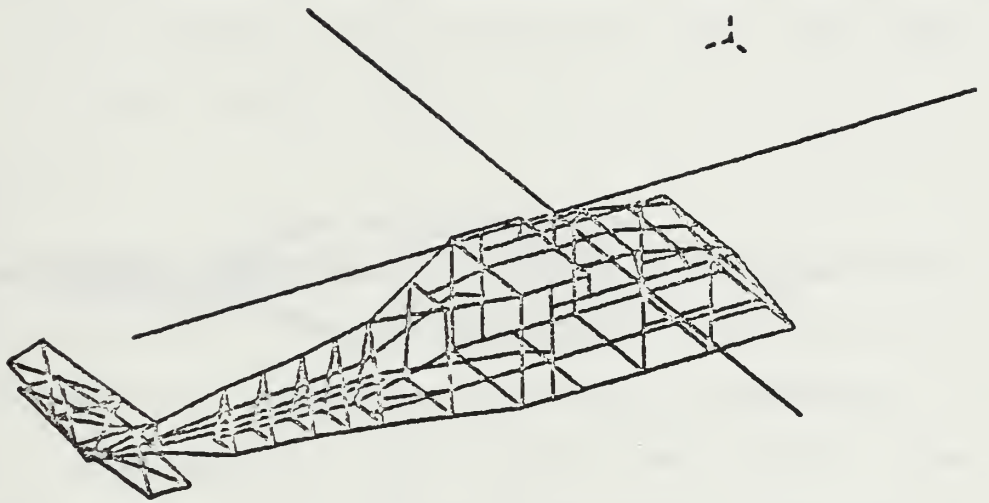


Figure 21 Sea Hawk Model with Transmission Line.

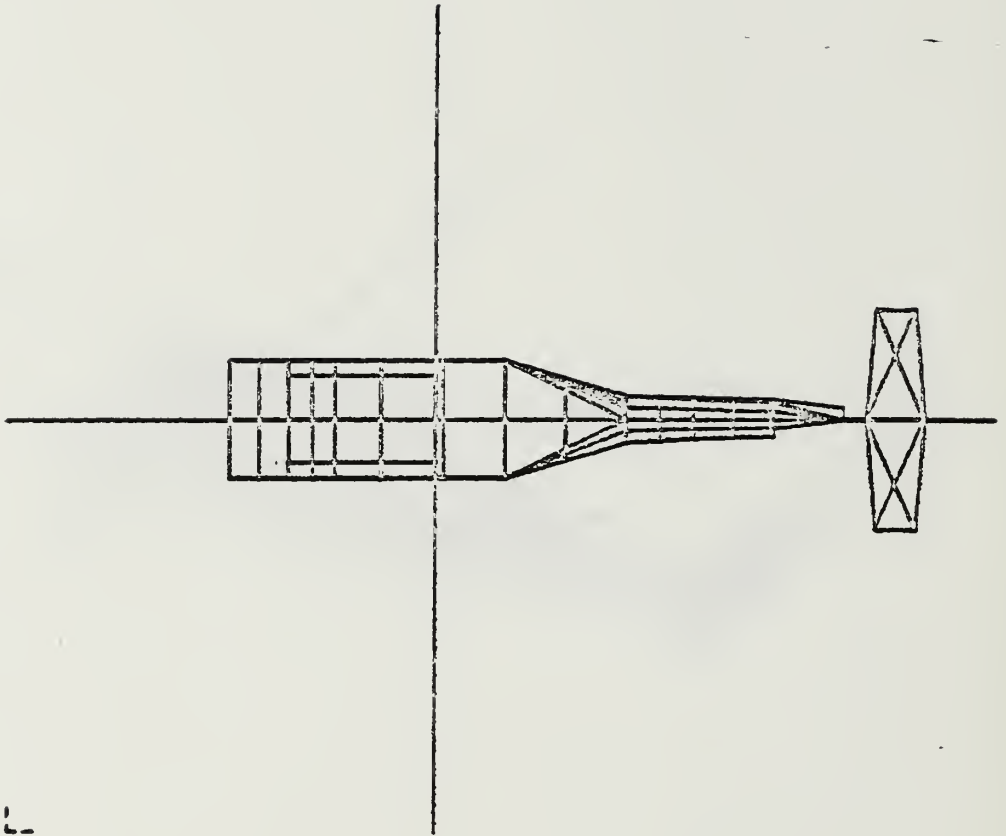


Figure 22 Sea Hawk Model with Transmission Line,
Top View.

became proportional to $1/f$ while the antenna current was proportional to f which was clearly wrong. The interaction matrix for the loops became ill-conditioned at the lower frequencies. Mr. Burke observed that this problem could be minimized by spacing the antenna further from the loops. Indeed, by moving the antenna out from 6 inches to 18 inches from the aircraft skin the code provided accurate results. [Ref. 15]

E. NEC RUNS

The NEC code computes the currents resulting from an applied excitation. The RF current distribution must meet the boundary condition that axial components of electric fields must go to zero along each wire. The excitation used in this study takes the form of an applied voltage at the antenna feed point which becomes a non-zero source field at the short segment of wire across the feed point with a zero excitation elsewhere on the structure. The currents are computed by NEC as described earlier, and finally radiation patterns are tabulated.

Individual NEC runs were made for each helicopter model at Coast Guard air-to-ground frequencies of 3.123, 5.696, and 8.984 MHz as well as at Naval Air Test Center frequencies of 4.040, 7.645, 13.974, and 18.100 MHz. For

each run the matrix for the helicopter itself was calculated as a Numerical Green's Function (NGF) partitioned matrix solution and recalled for use with the various antenna models. This procedure allowed multiple radiation patterns to be collected for each antenna configuration at a specified frequency with one run in a fraction of the CPU time otherwise required. Even so, each run required 30 to 45 minutes of CPU time (IBM 370/3033). It was discovered that the NGF was too large to be stored on the users own disk, and that spooling the file to and from the reader (main frame storage) cost more money than the calculation of the NGF itself. Consequently, the NGF was re-calculated for each run.

Each model was validated using the code's average gain calculation. This was a performance criteria based on volumetric pattern integration and has been known to be an excellent self-validation tool [Ref. 13]. Correlation of the NEC horizontal plane radiation patterns with actual antenna test range data was also performed.

IV. RESULTS

A. GENERAL

NEC free space radiation patterns were obtained for each helicopter/antenna configuration at frequencies of 3.123, 4.040, 5.696, 7.645, 8.984, 13.974, and 18.1 MHz. Four cuts were taken for each configuration at each frequency:

1. Horizontal plane, $\theta = 90$ degrees
2. Elevation 64 degrees above horizontal, $\theta = 26$ degrees
3. Vertical plane, nose to tail, $\phi = 0$ degrees
4. Vertical plane, offset, $\phi = 45$ degrees

Vertically and horizontally polarized gains as well as total gain were plotted relative to isotropic signal levels in decibels (dBI). Patterns at frequencies above 10 MHz were included solely to compare the NEC output with test range data since NVIS propagation required use of the lower end of the HF spectrum (2 to 10 MHz). Vertical plane plots were included only as a matter of interest. Sample radiation pattern plots have been shown in Figures 23 through 26.

Comparison of horizontal plane radiation patterns with antenna test range data revealed satisfactory correlation for the horizontally polarized gains. The

H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

COLLINS 437R-2, FREE SPACE, HORIZ CUT, THETA=90

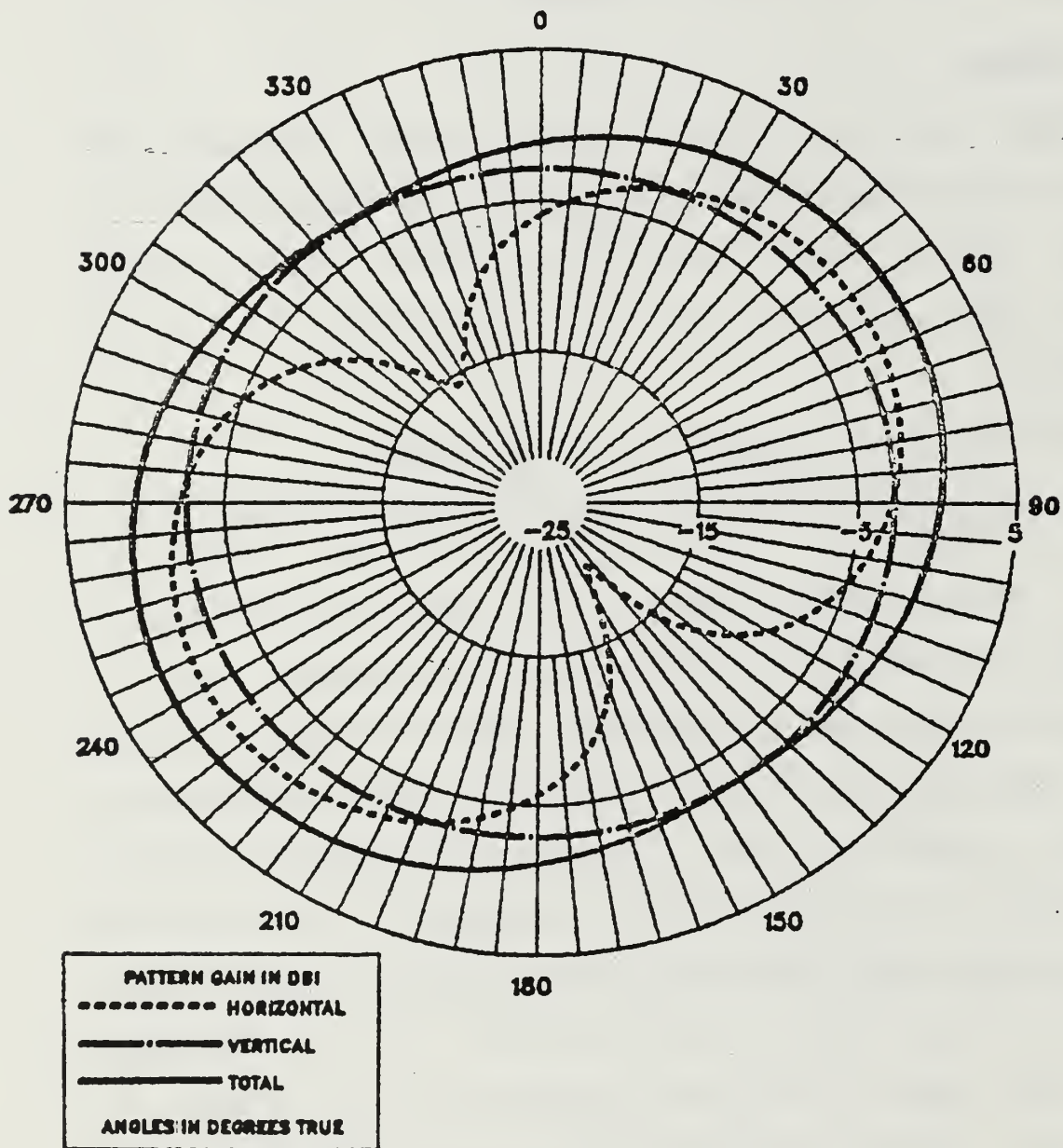


Figure 23 Radiation Pattern, Horizontal Plane,
Theta = 90.

H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

COLLINS 437R-2, FREE SPACE, HORIZ CUT, THETA=26

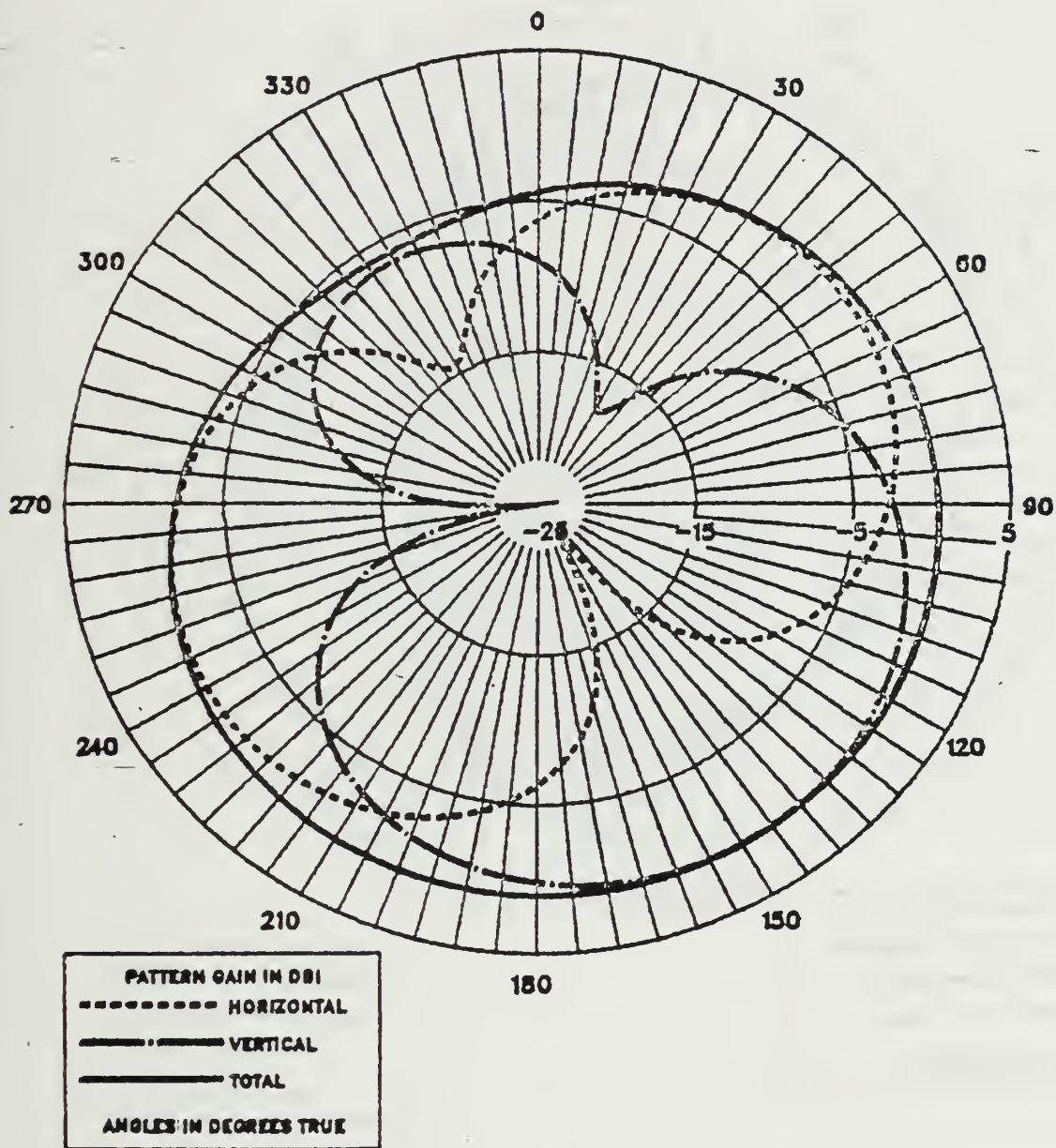


Figure 24 Radiation Pattern, Elevated Plane,
Theta = 26.

H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

COLLINS 437R-2, FREE SPACE, VERT CUT, PHI=0

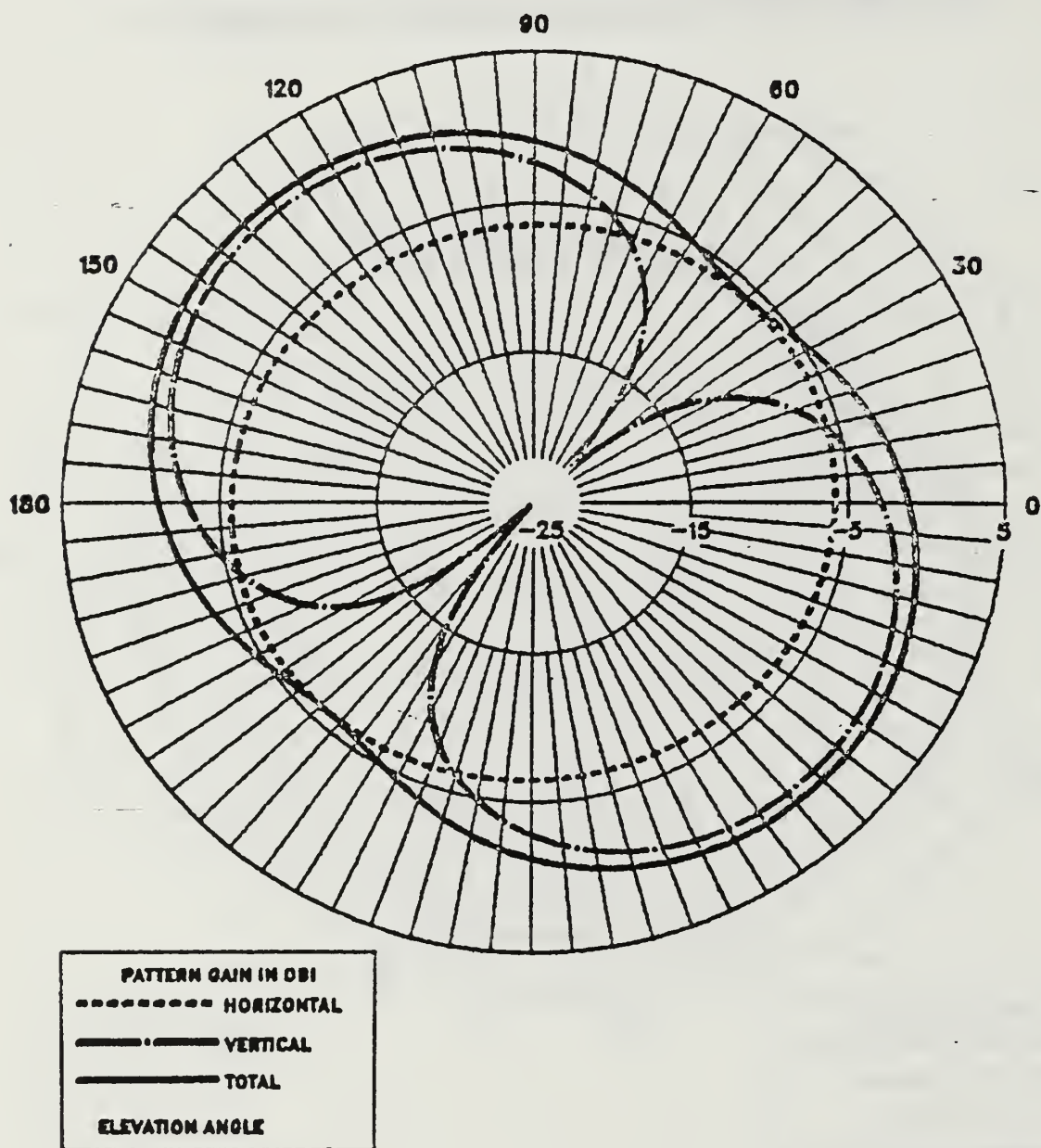


Figure 25 Radiation Pattern, Vertical Plane,
Phi = 0.

H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

COLLINS 437R-2, FREE SPACE, VERT CUT, PHI=45

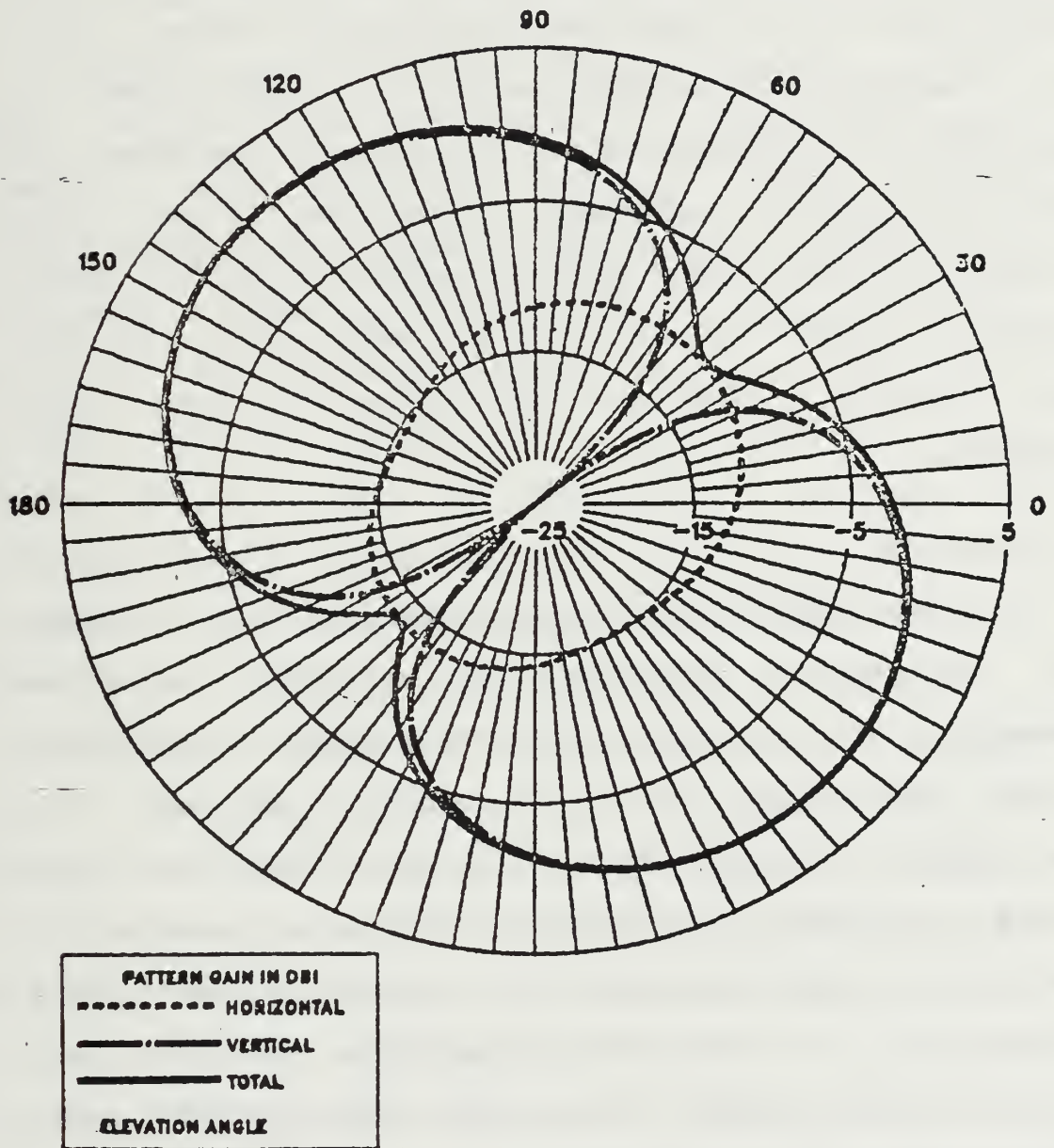


Figure 26 Radiation Pattern, Offset Vertical Plane,
Phi = 45.

NEC generated vertically polarized gain patterns were much stronger than the test range data. This was believed to be because the test range data was not corrected for the surface wave contribution [Refs. 1, 2, 16]. The shape of the NEC generated vertically polarized gain patterns corresponded well with test range data, as did the relative improvement or decrement in gain from long-wire to Navy tuned monopole antenna patterns. These positive correlations validated the model results insofar as relative comparisons of antenna systems were concerned.

B. DOLPHIN

As discussed earlier, enhanced ground wave coverage is achieved by maximizing the vertically polarized signals in the horizontal (azimuthal) plane. Horizontal plane cuts showed both loop antennas produced low vertically polarized gains (-10 to -15 dBI) and were quite directional. The long-wire antenna produced better vertically polarized gain (-5 to -10 dBI) but was still directional. The tuned monopole produced good vertically polarized gain (about -2 to -3 dBI) and was truly omnidirectional at all frequencies.

Performance in the NVIS mode was judged by total gain in the elevated cut. All four antennas performed well (virtually isotropic) with omnidirectional

characteristics for each except that the tuned monopole exhibited slight directionality.

C. SEA HAWK

A problem was discovered with the long-wire antenna model on the Sea Hawk at 5.696 MHZ. An apparent model resonance was encountered causing gains to be significantly inflated while pattern shapes appeared to be correct. Model resonance has been encountered in the past [Ref. 8], but with different manifestations. This problem was not encountered at the adjacent test frequencies of 4.040 and 7.645 MHZ, nor was it encountered with any other antenna configuration at any frequency. The long-wire configuration at 5.696 MHZ was, therefore, not reflected in the following discussion.

As in the Dolphin results, the vertically polarized gain in the horizontal plane cut of the loop antenna was always low and was directional at all but one frequency. The long-wire and Navy tuned monopole installations had vertically polarized gains that typically peaked between -5 and 0 dBI but were highly directional. The tuned monopole installed as on the Dolphin produced a gain of -5 dBI but was truly omni-directional at all frequencies.

In the NVIS mode the total gains were found to be virtually at isotropic levels and omni-directional for all antenna configurations except that the Navy tuned

monopole installation appeared to produce about +6 dBI
total gain.

V. CONCLUSIONS AND RECOMMENDATIONS

A. DOLPHIN

This study proves that the Collins 437R-2 HF Tuned Monopole antenna is the correct replacement for the Dolphin's troubled long-wire installation. Placement seems to be adequate, but further study and modeling could be performed to determine whether this location is truly optimum.

B. SEA HAWK

Based on the candidate antennas addressed in this study, an installation of the Collins 437R-2 tuned monopole antenna on the Sea Hawk in a configuration similar to that on the Dolphin is the best course of action to enhance HF performance on that aircraft. Further study to determine optimum antenna location would be useful. Especially important is "model tuning" as described in Ref. 7 to determine long-wire performance at the Coast Guard's primary air-to-ground frequency of 5.696 MHZ.

C. ADDITIONAL STUDIES

The modeling done in this study assumes that the transmitter and coupler aboard the helicopter can be

matched effectively with the candidate antennas at the frequencies tested. Follow-on studies could investigate the input impedance of these antenna installations and assess the degree of compatibility with existing matching networks.

Another interesting aspect to be studied is the possible "Rusty Bolt Effect." The possibility exists that the method used to "electrically isolate" pieces of the airframe, or the composite core itself, being in the vicinity of the HF antenna, may cause undesired semiconducting effects at junctions and interfaces. The resulting intermodulation products can seriously degrade the performance of a variety of avionics. [Ref. 17]

Although currently being studied by another university, a study and analysis of the antenna test range measurement methods at the Naval Air Test Facility, NAS Patuxent River, Maryland, could provide good thesis material for a student interested in applying antenna theory to a "real life" situation.

E. SUMMARY

Accurate electromagnetic models were created via the IGUANA program for the Dolphin and Sea Hawk helicopters as well as for long-wire, tuned monopole, and shunted-loop transmission-line-type antennas. The criteria for judging HF system effectiveness was devised from results

of the Advanced Prophet program. The models were used as input for the NEC program and the resulting radiation patterns were analyzed to select the optimum antenna configuration which met mission needs for each aircraft.

If the procedures and techniques for HF system modeling presented herein are utilized much time and money can be saved when designing or reconfiguring HF systems for optimum performance.

LIST OF REFERENCES

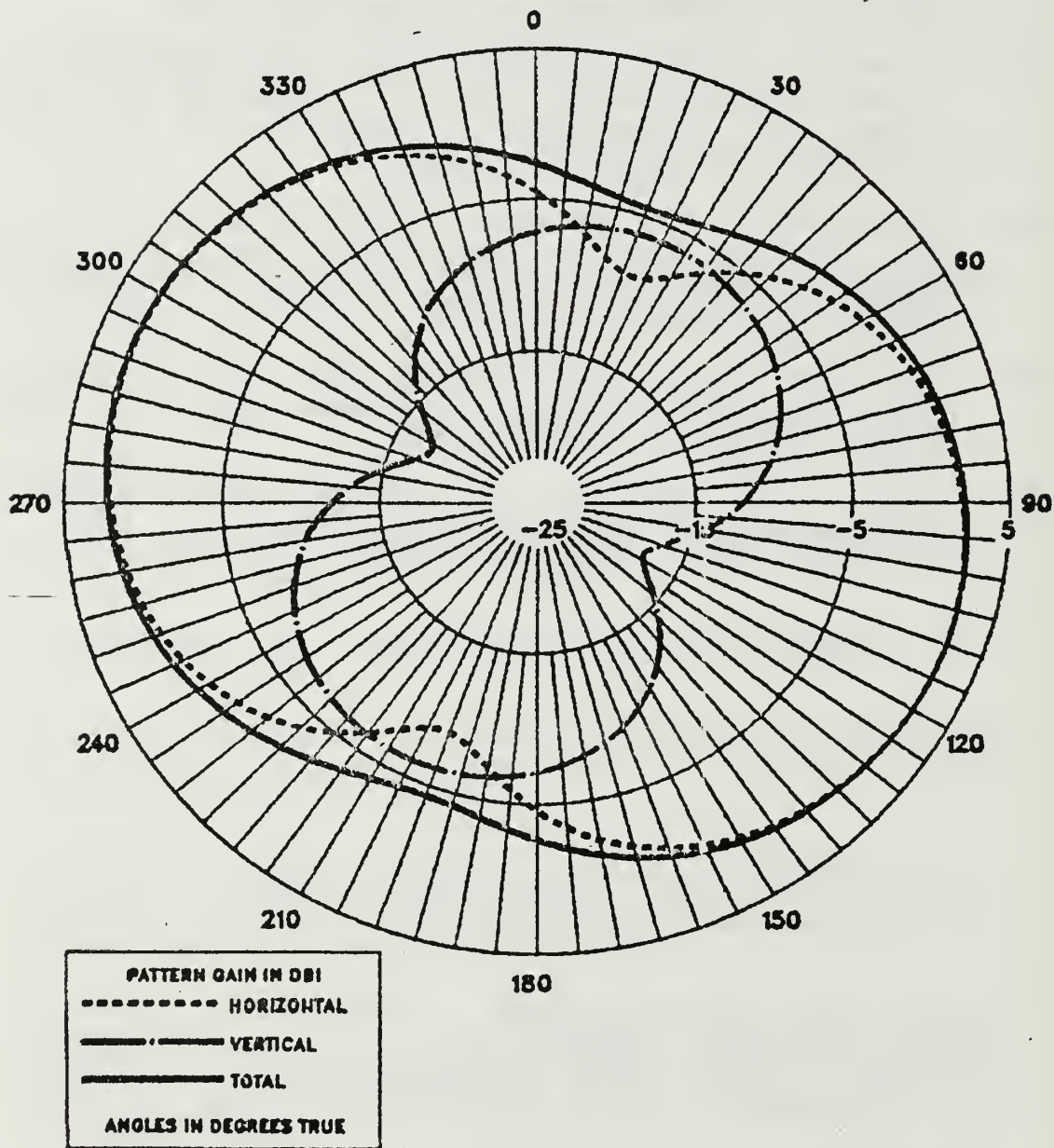
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17. Landt, J.A. "Effects of Nonlinear Loads on Antennas and Scatterers," AGAARD Lecture Series 131, 1983.

APPENDIX A
NEC RADIATION PATTERN PLOTS

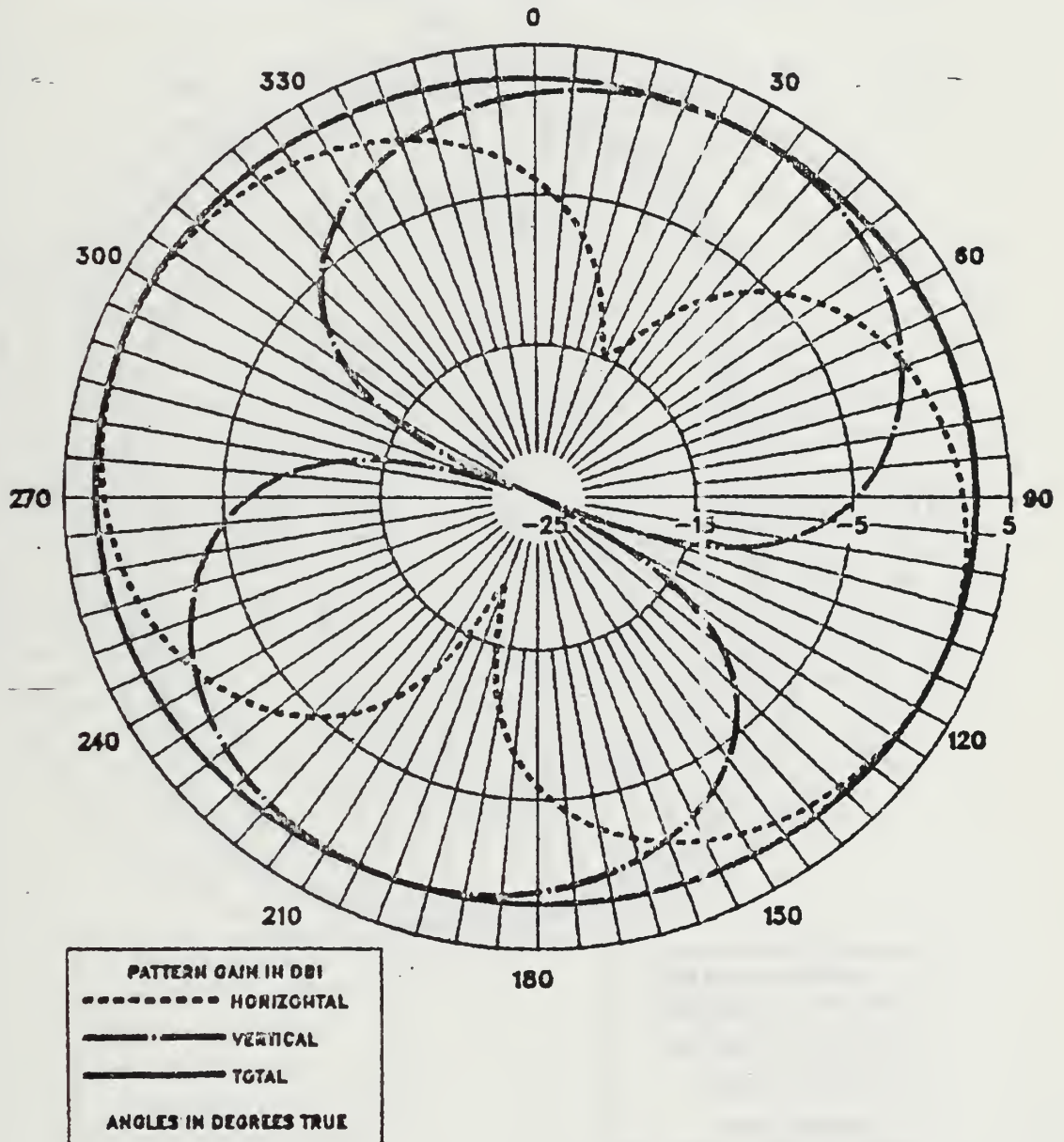
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LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



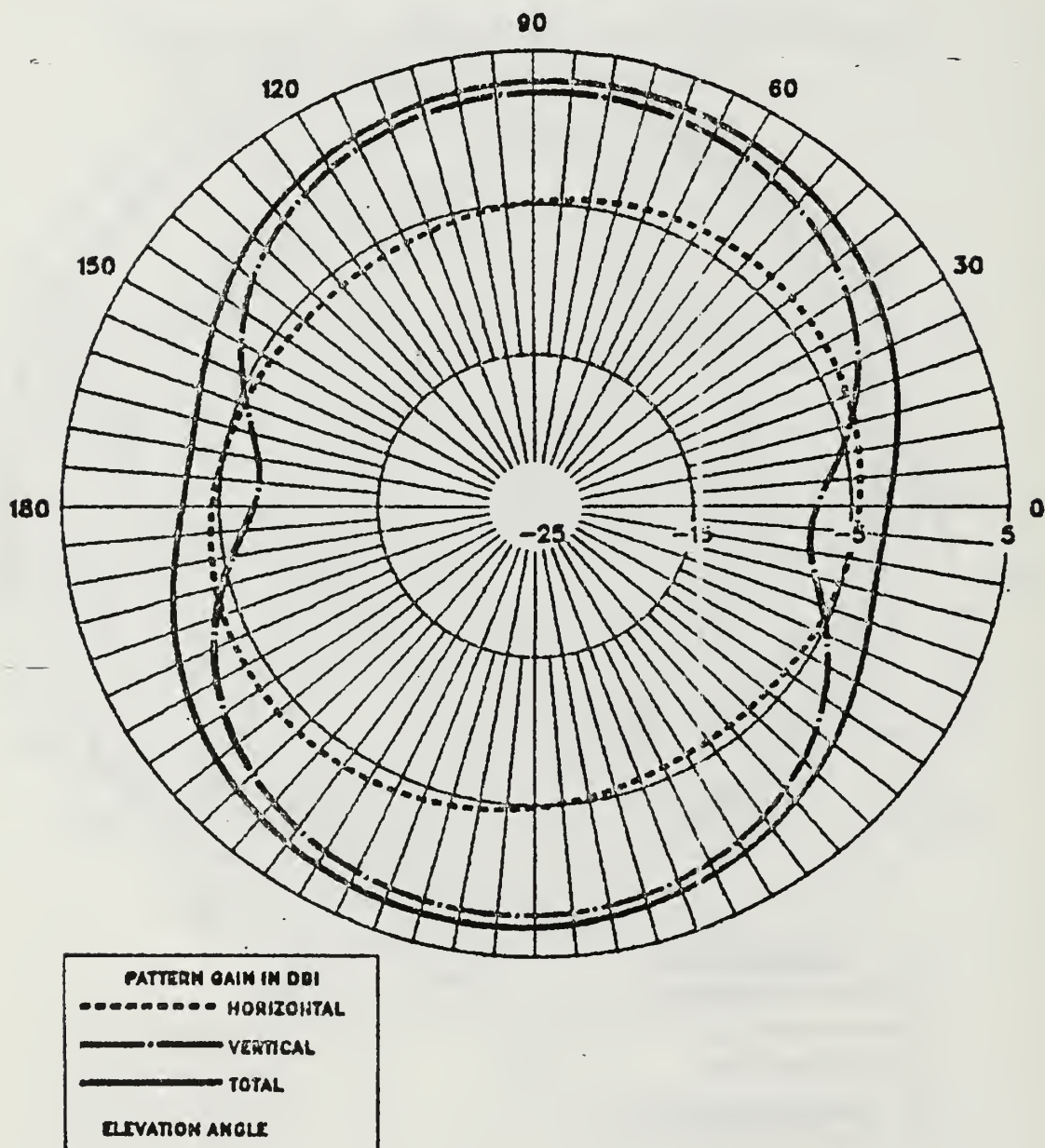
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LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



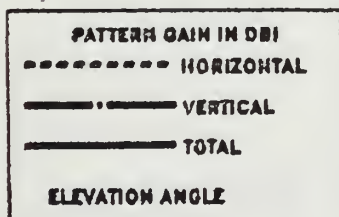
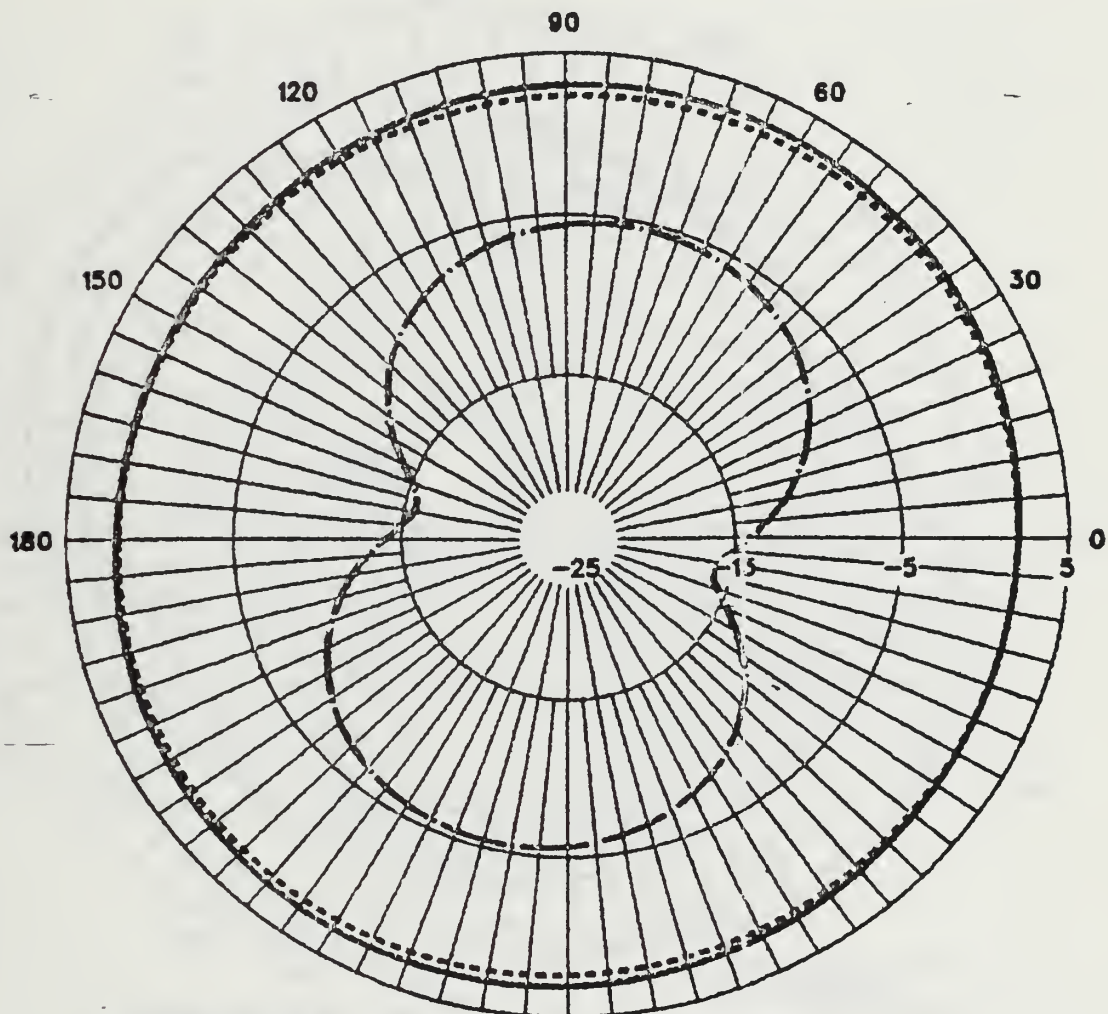
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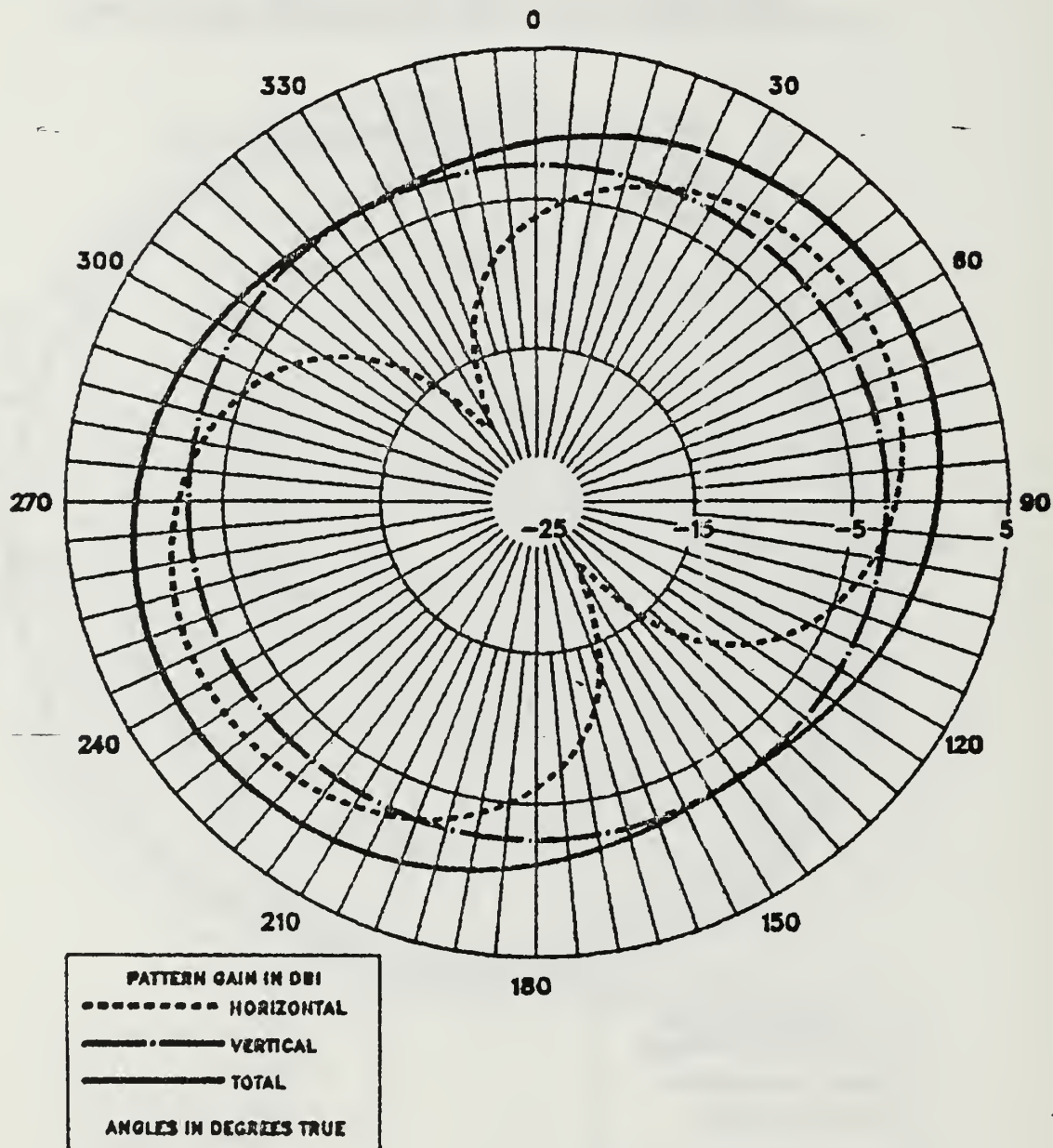
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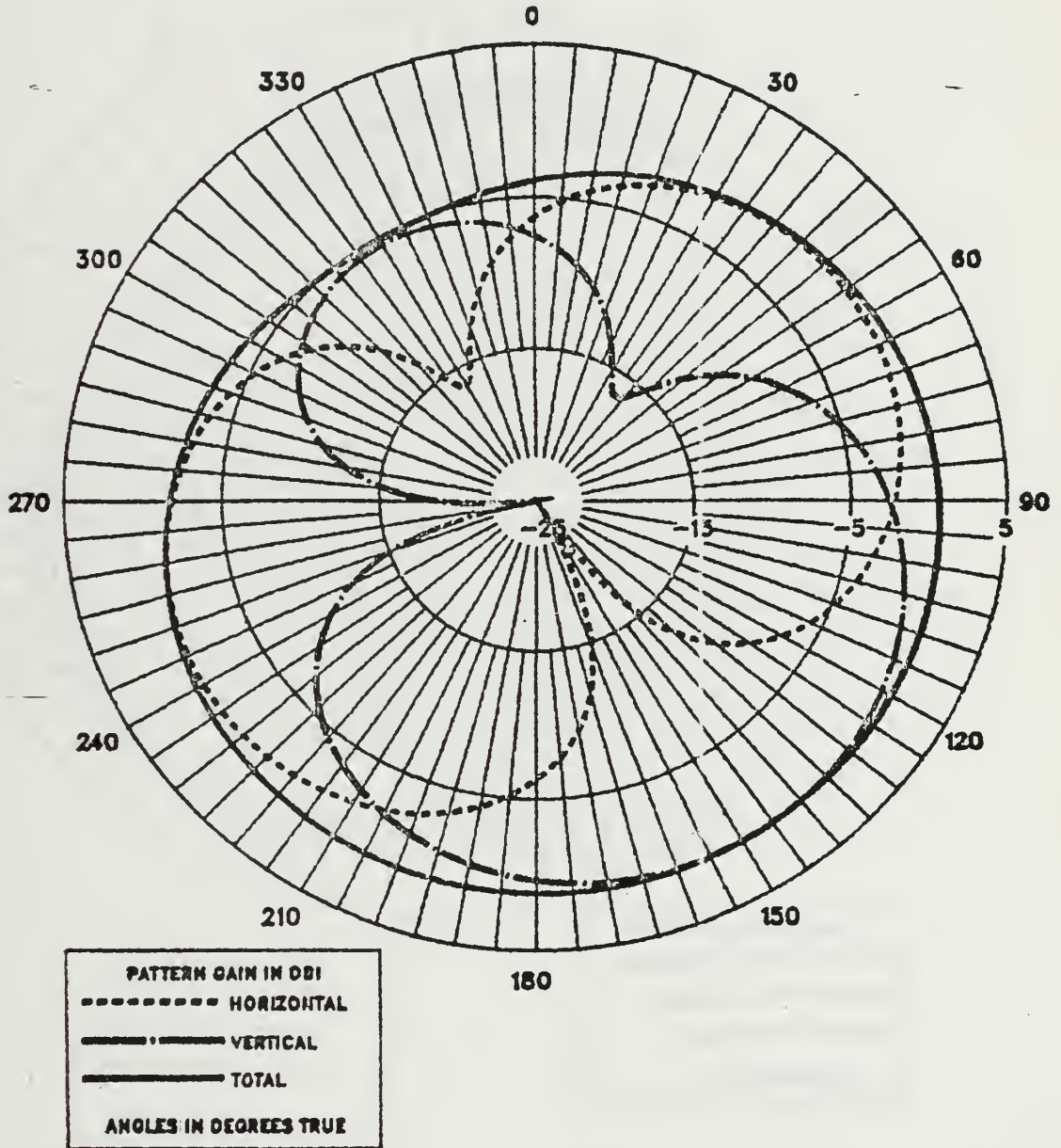
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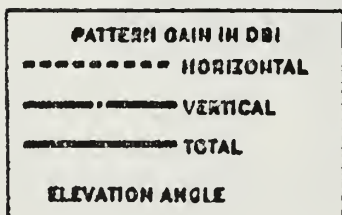
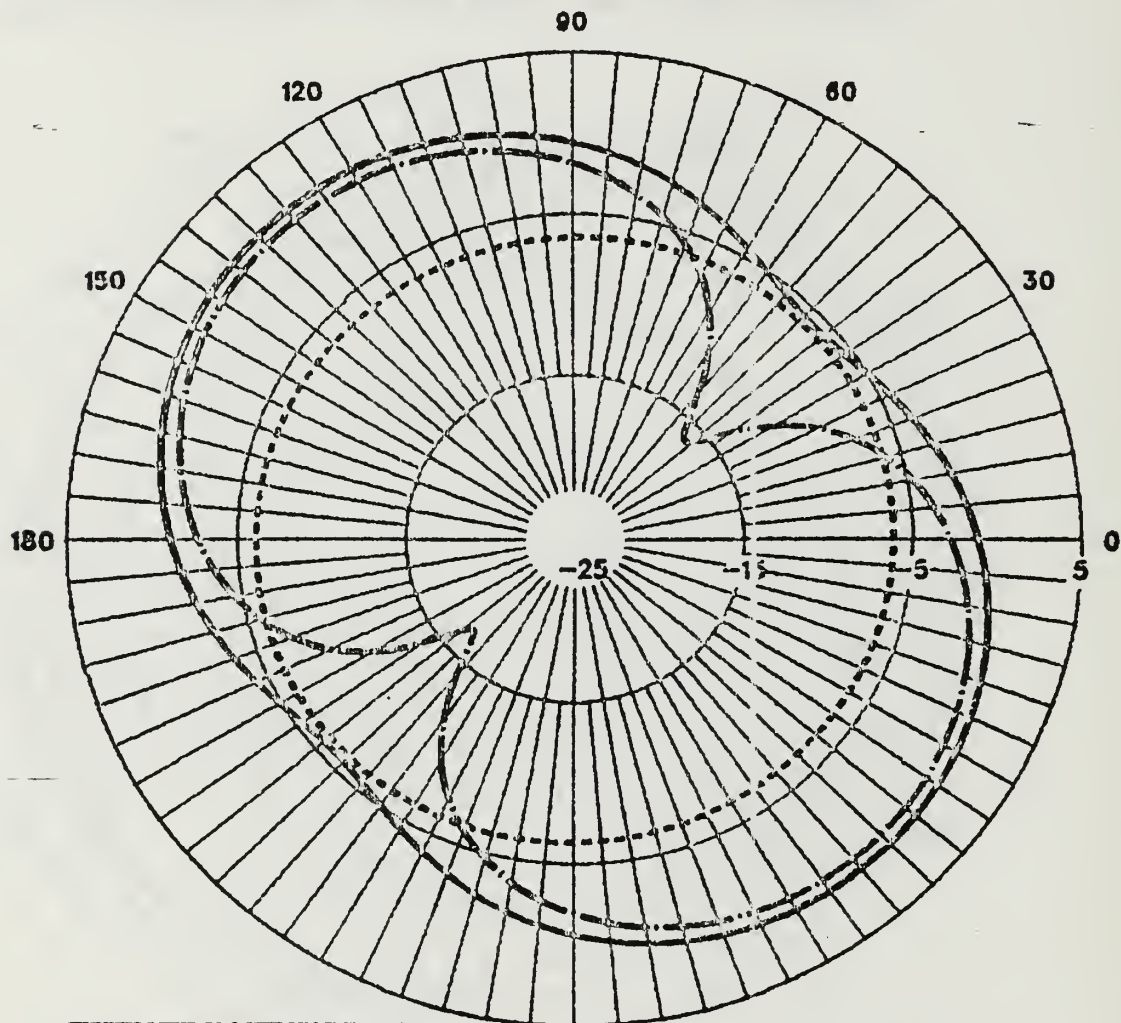
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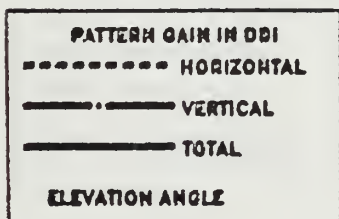
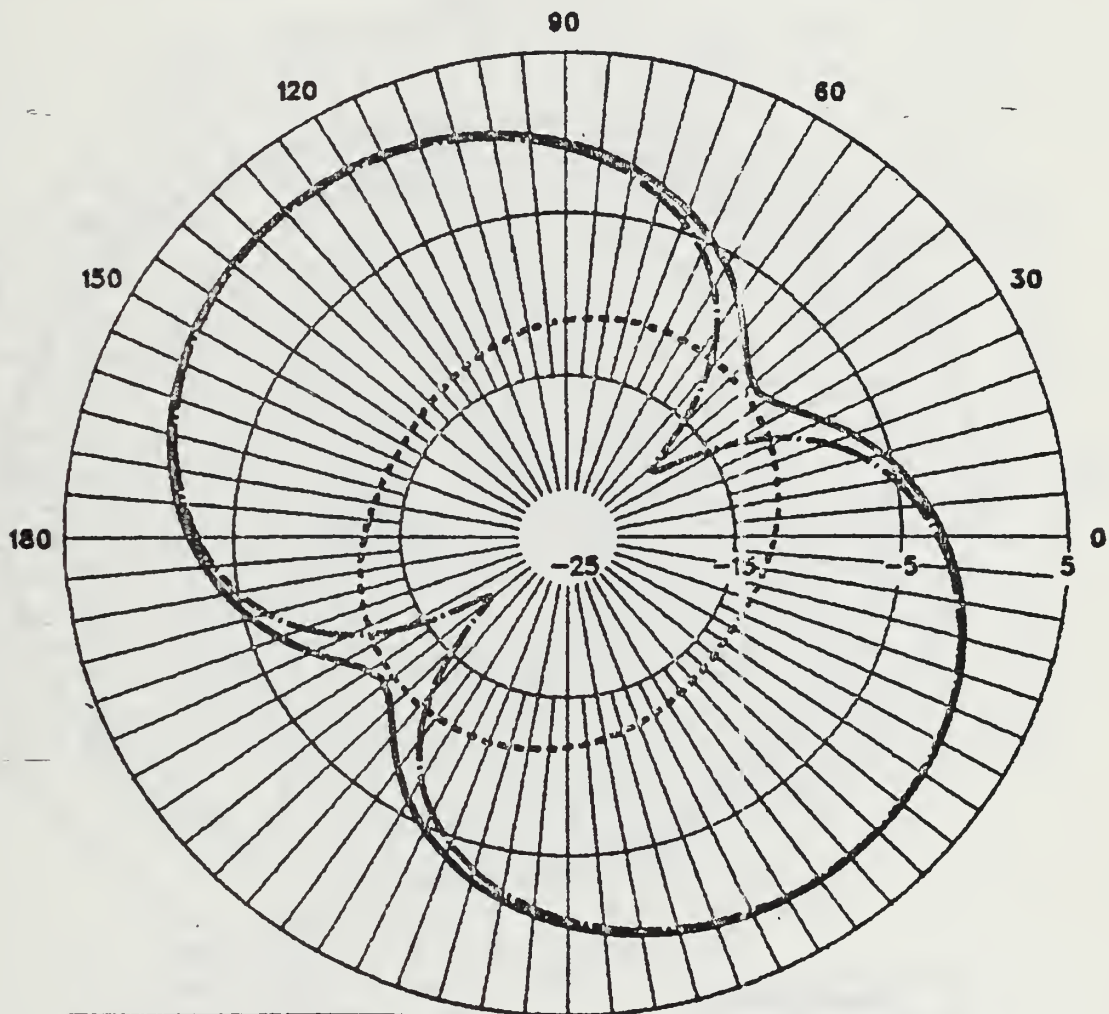
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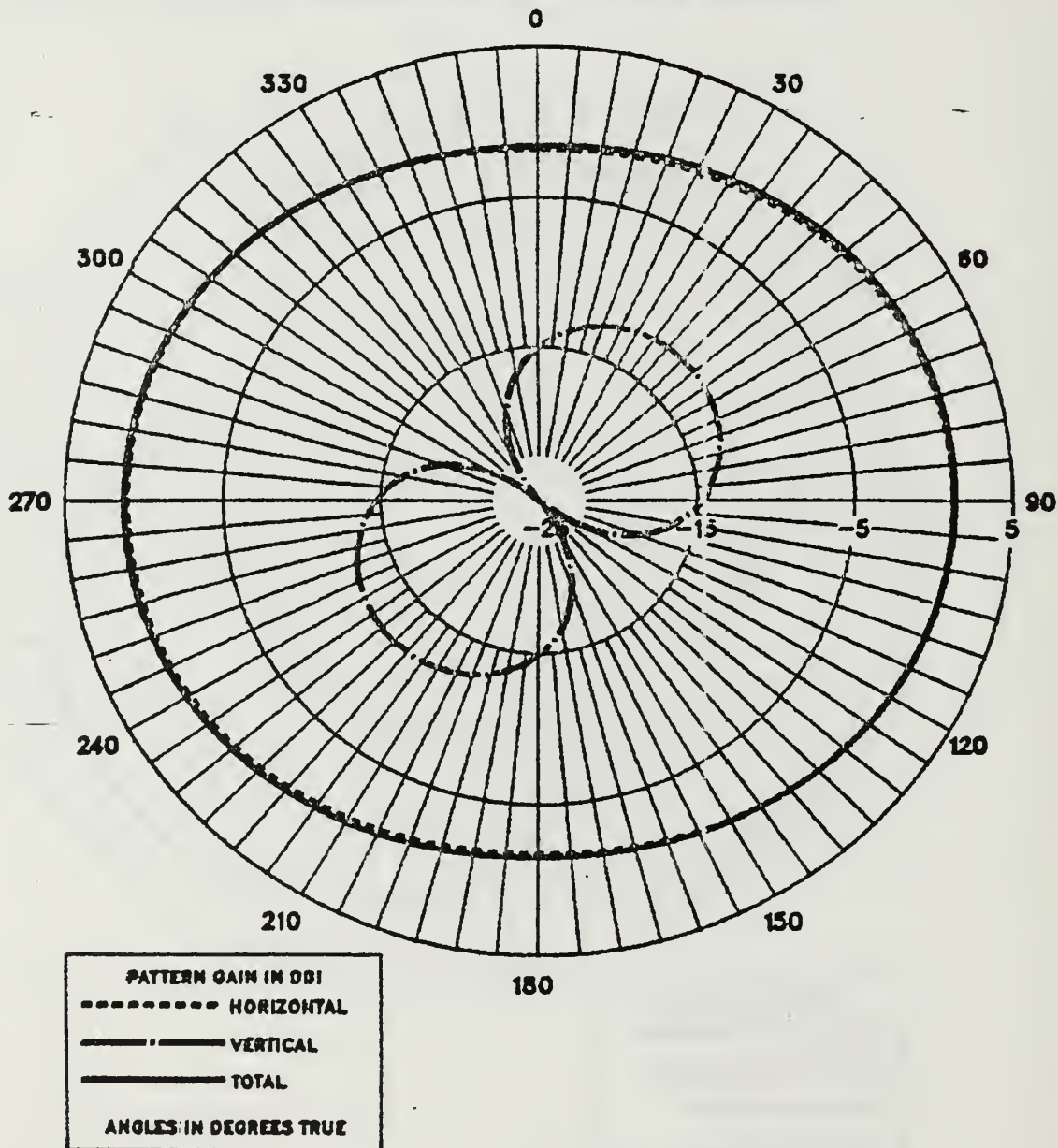
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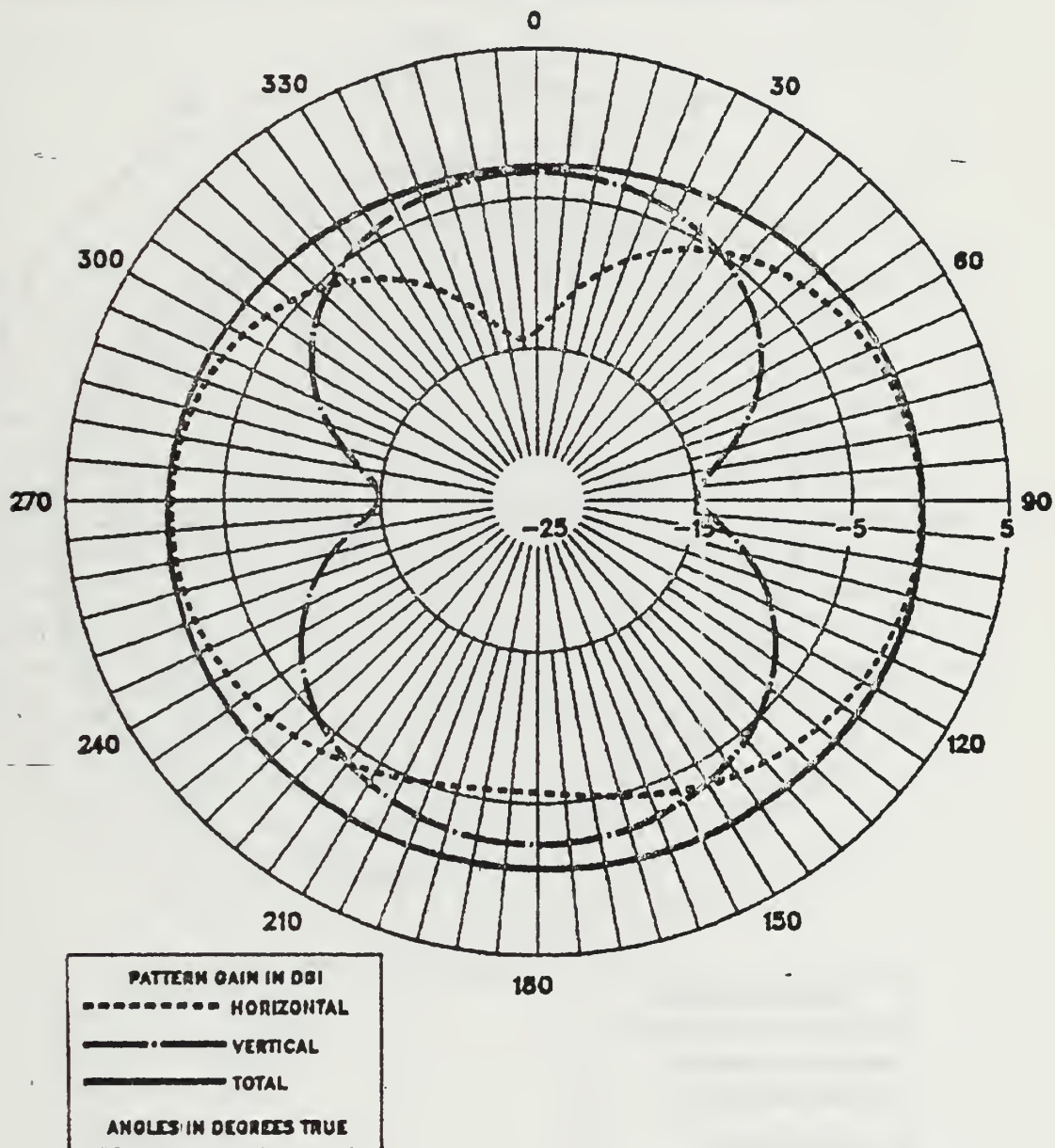
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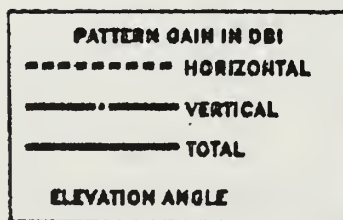
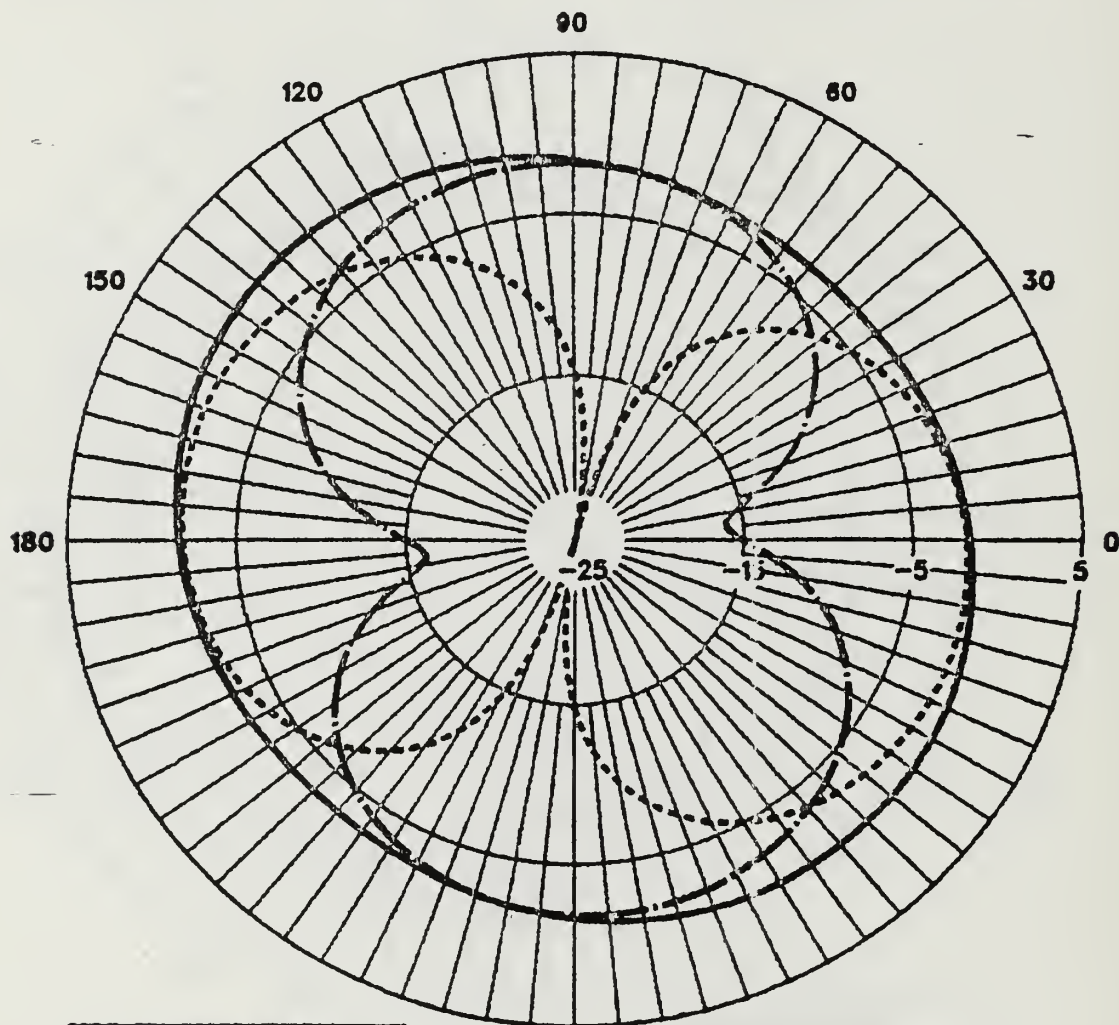
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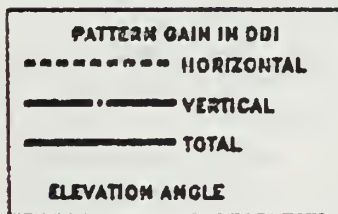
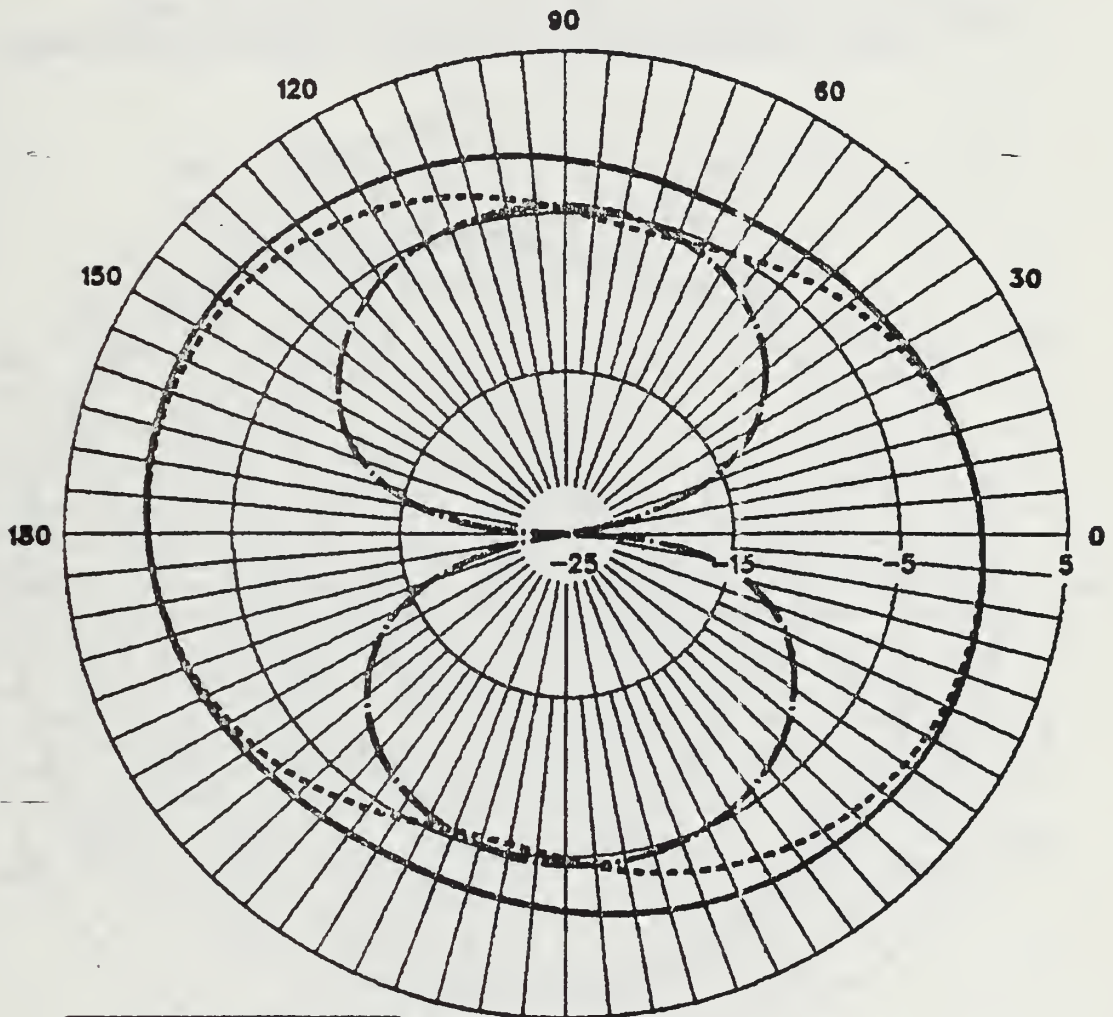
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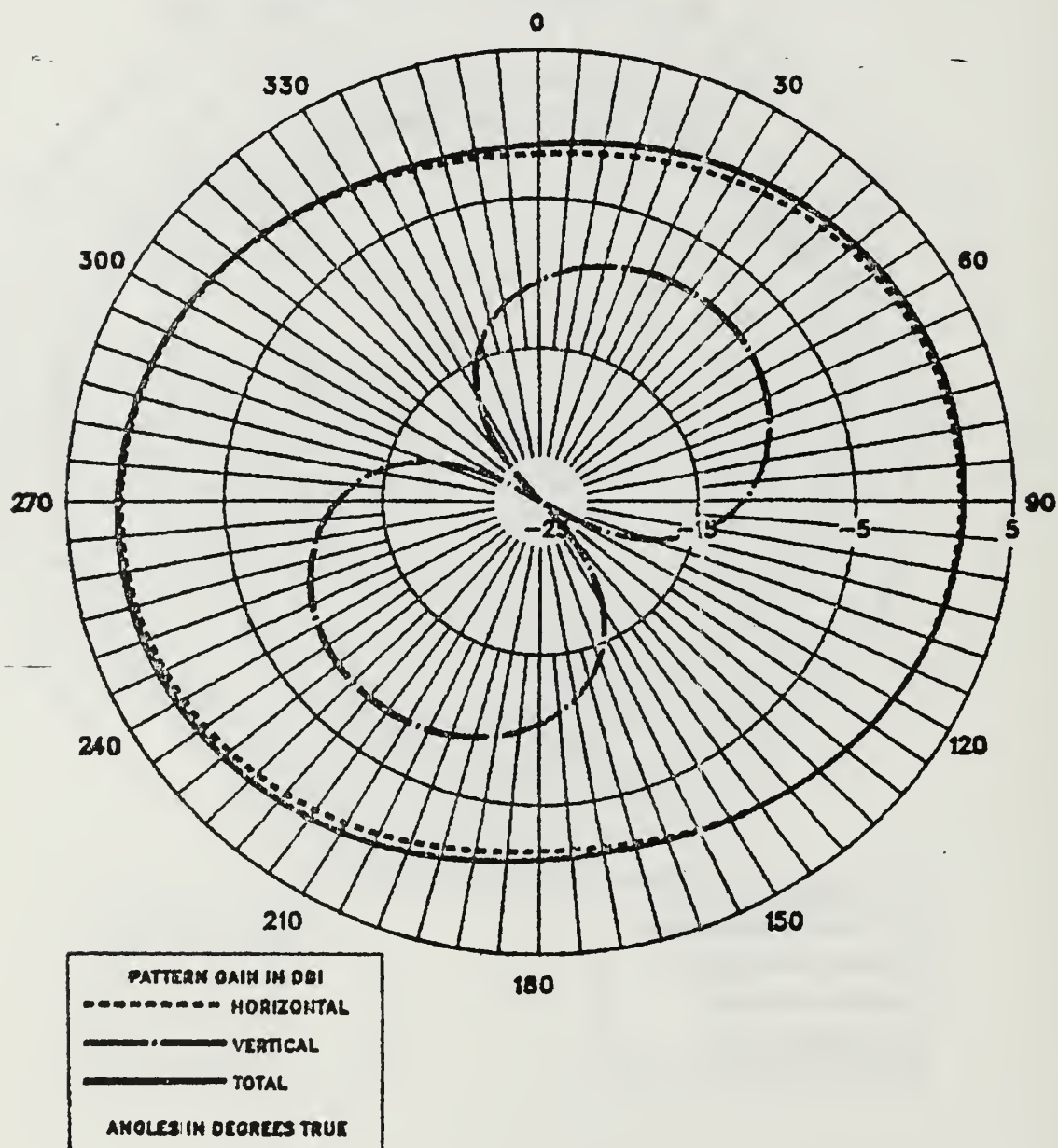
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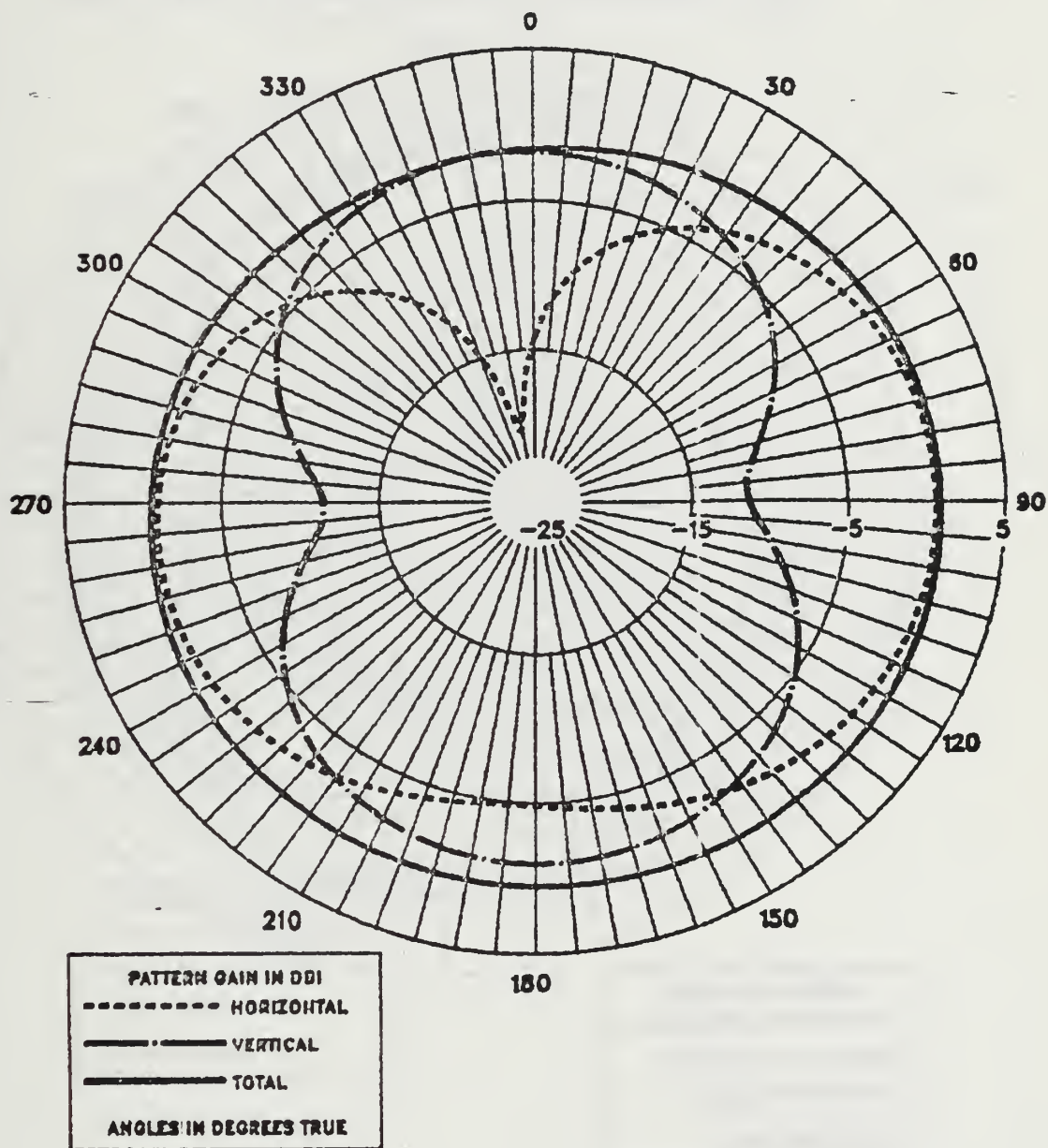
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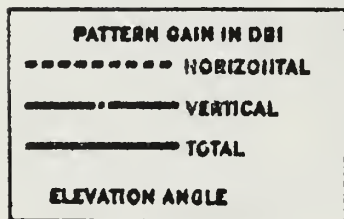


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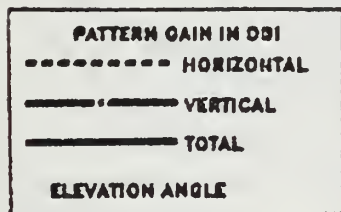
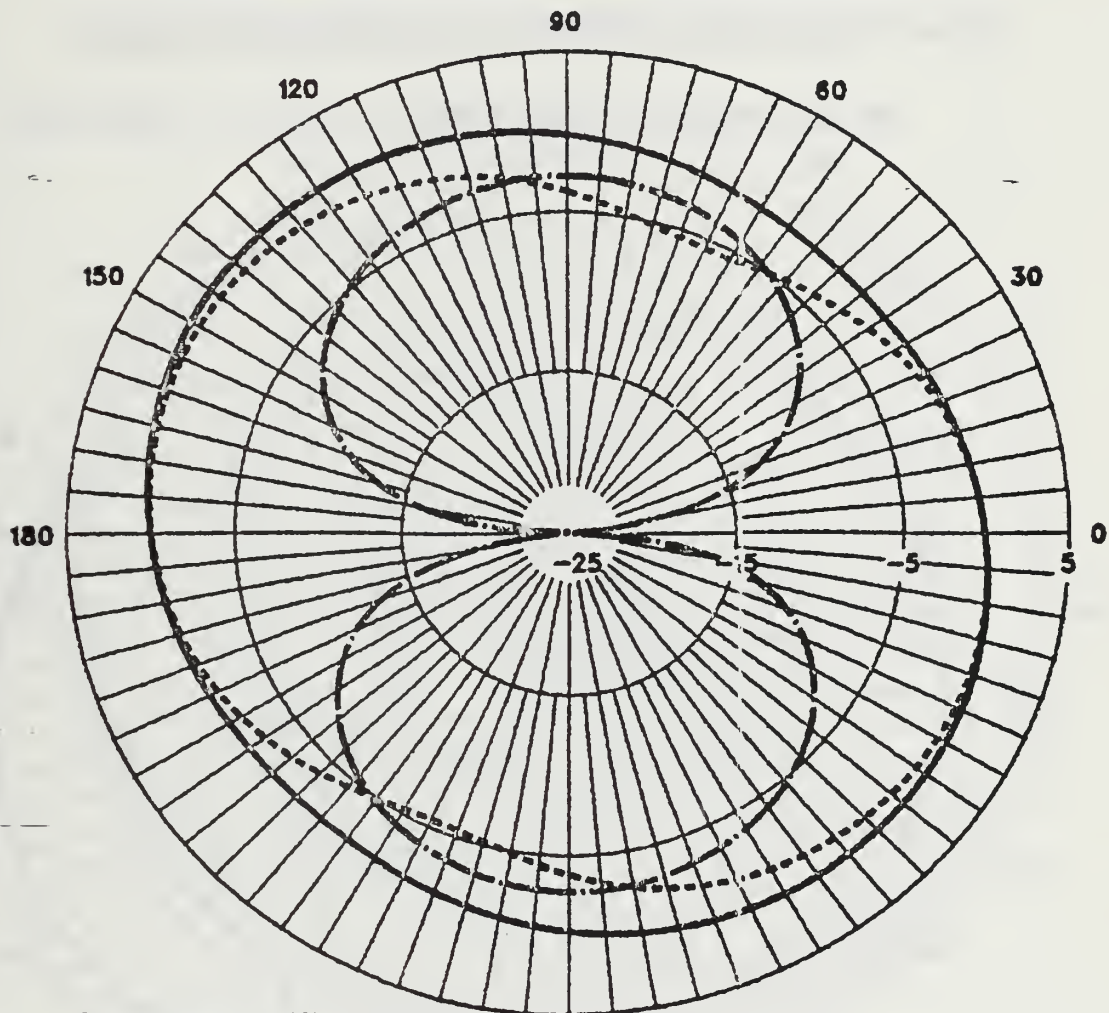


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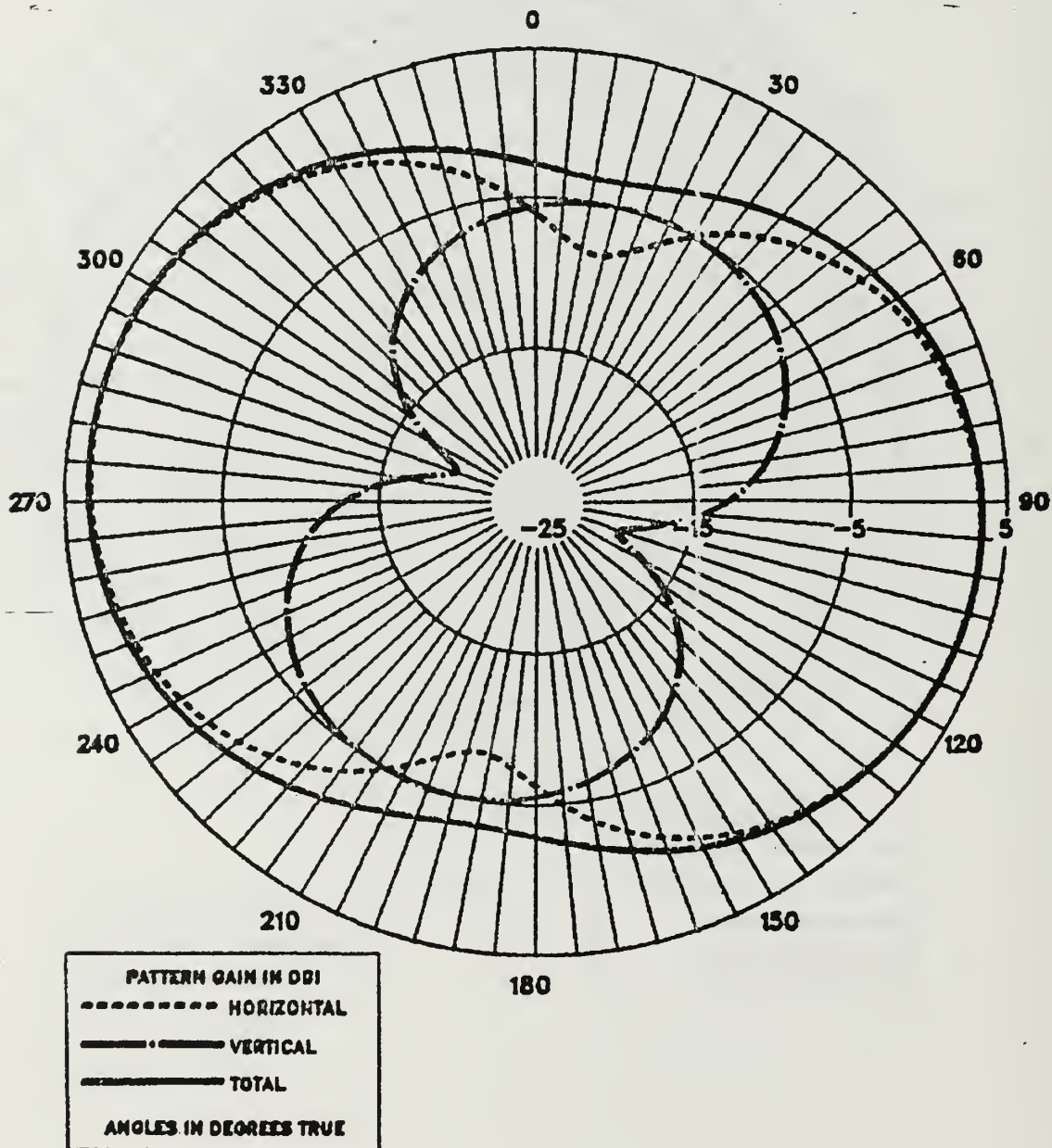
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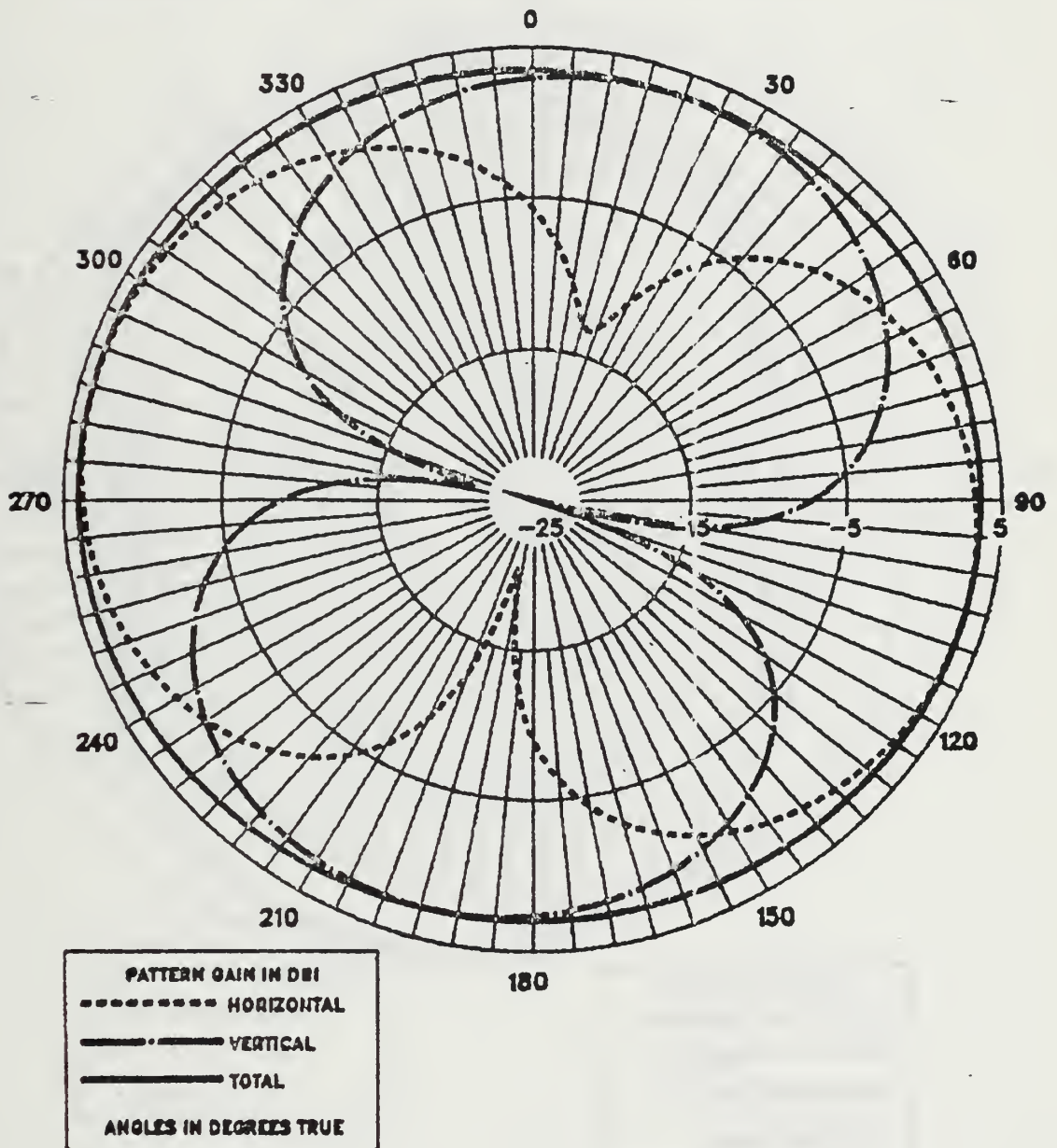
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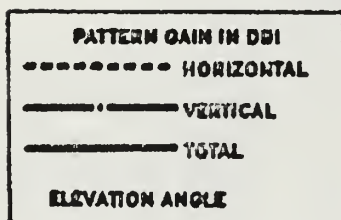
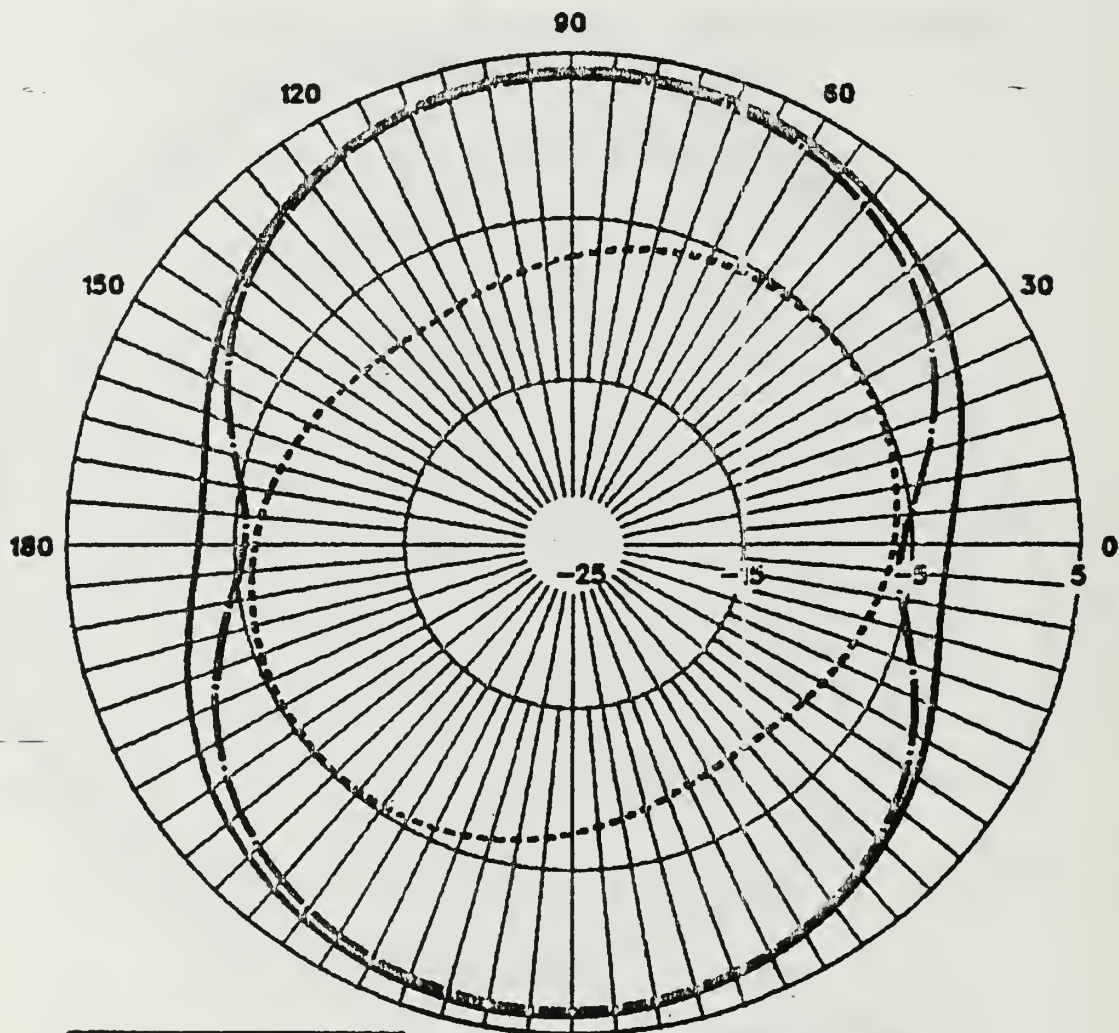
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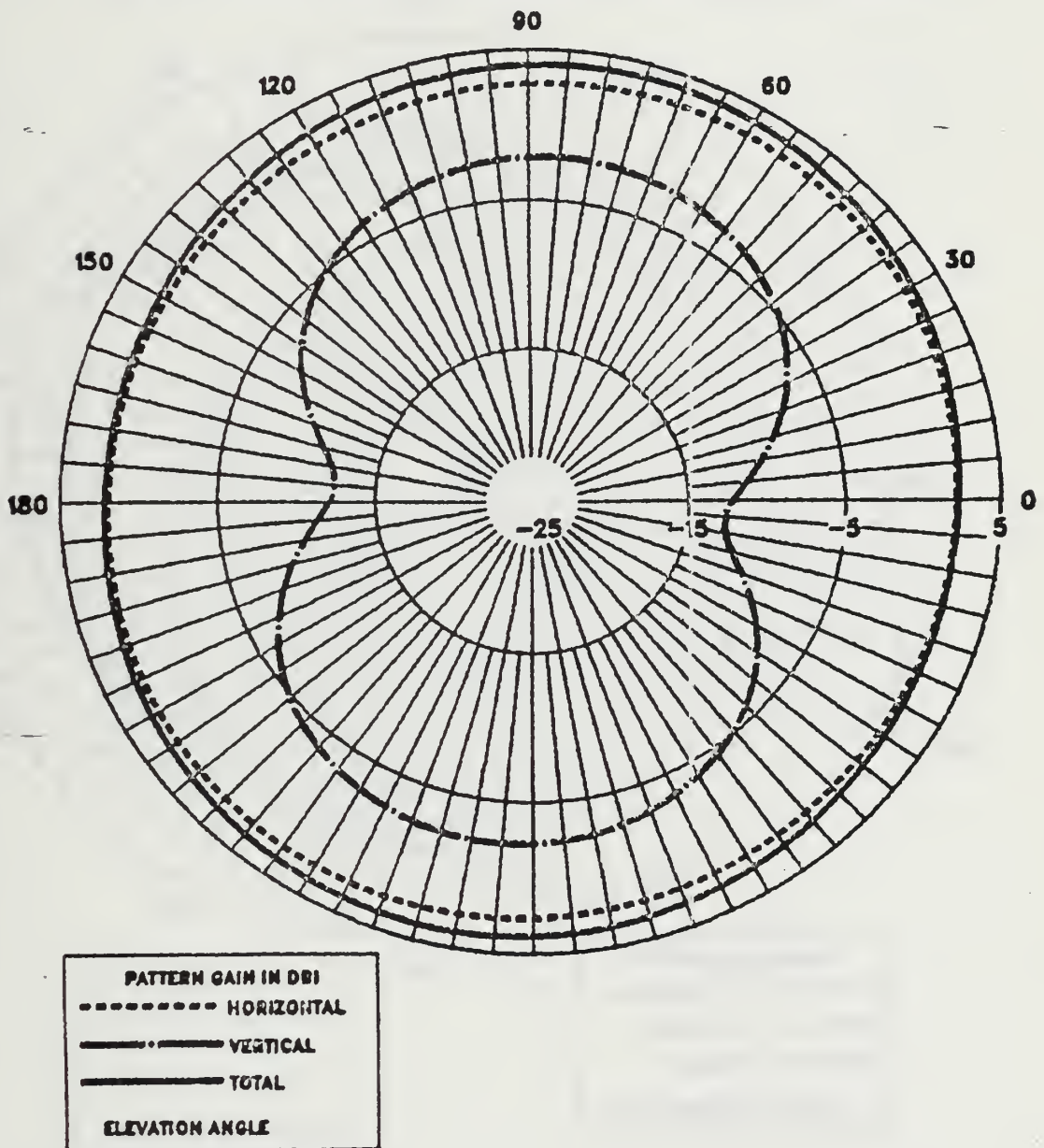
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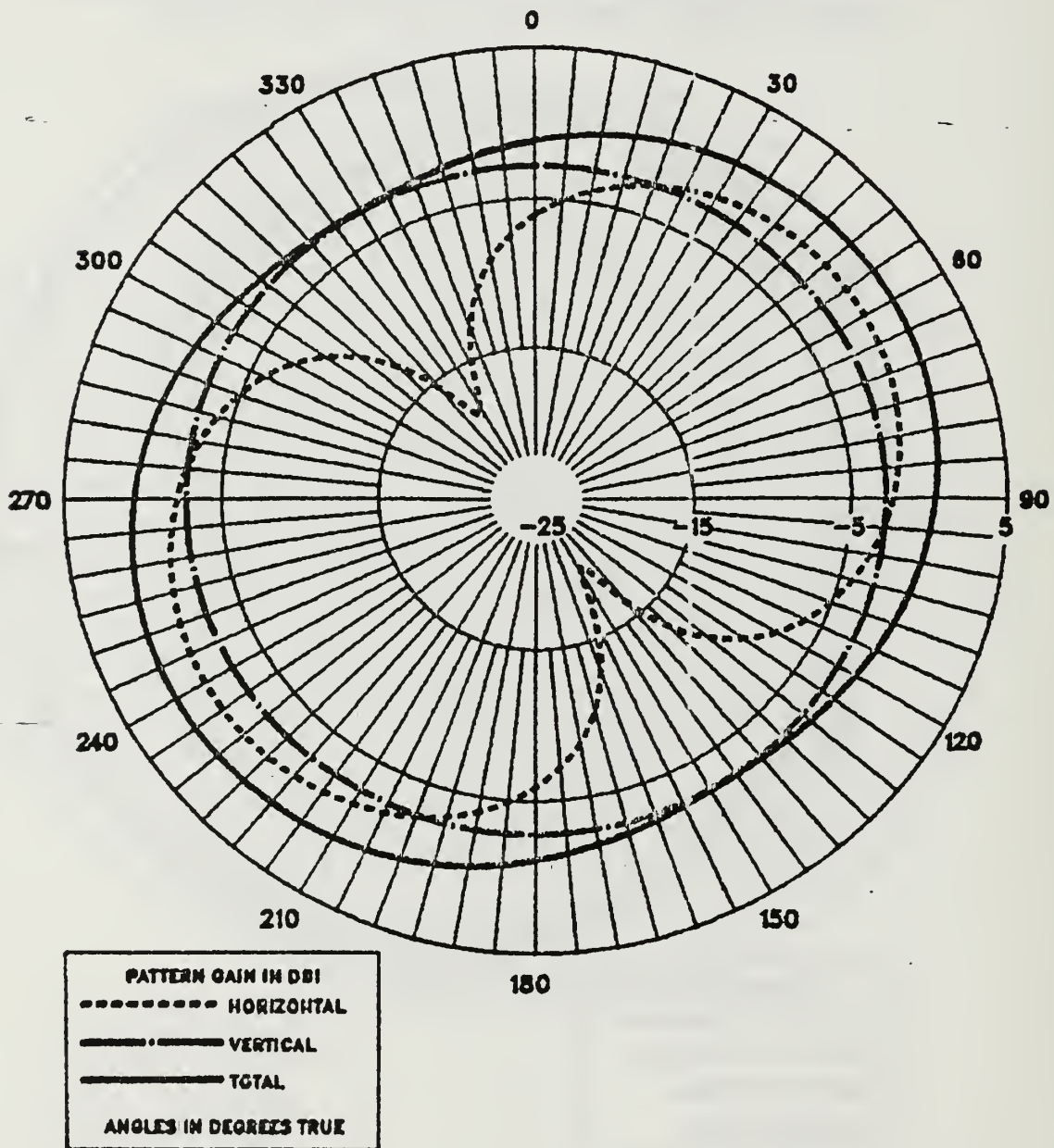
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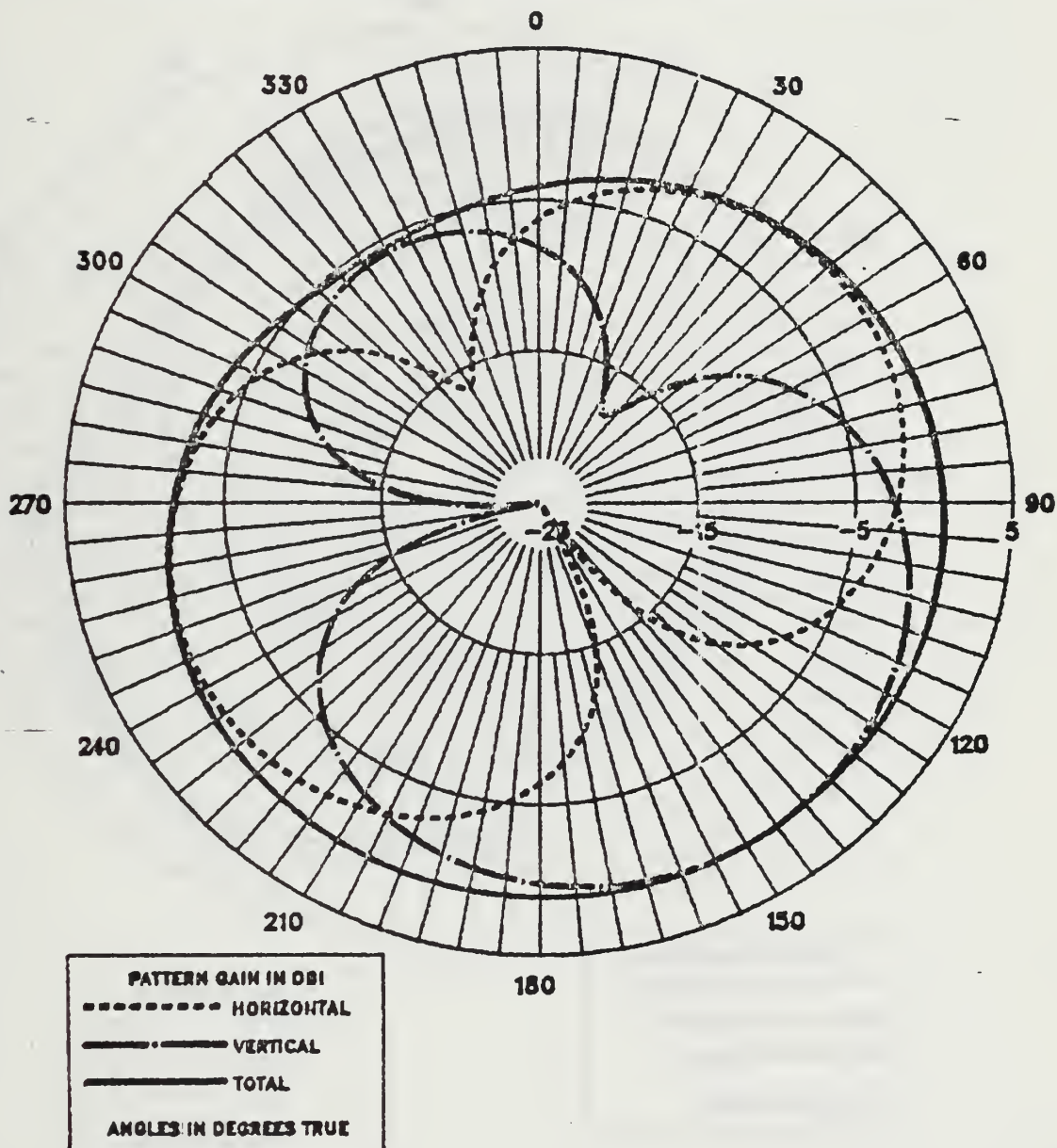
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COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



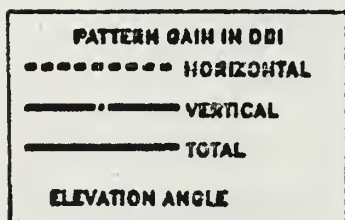
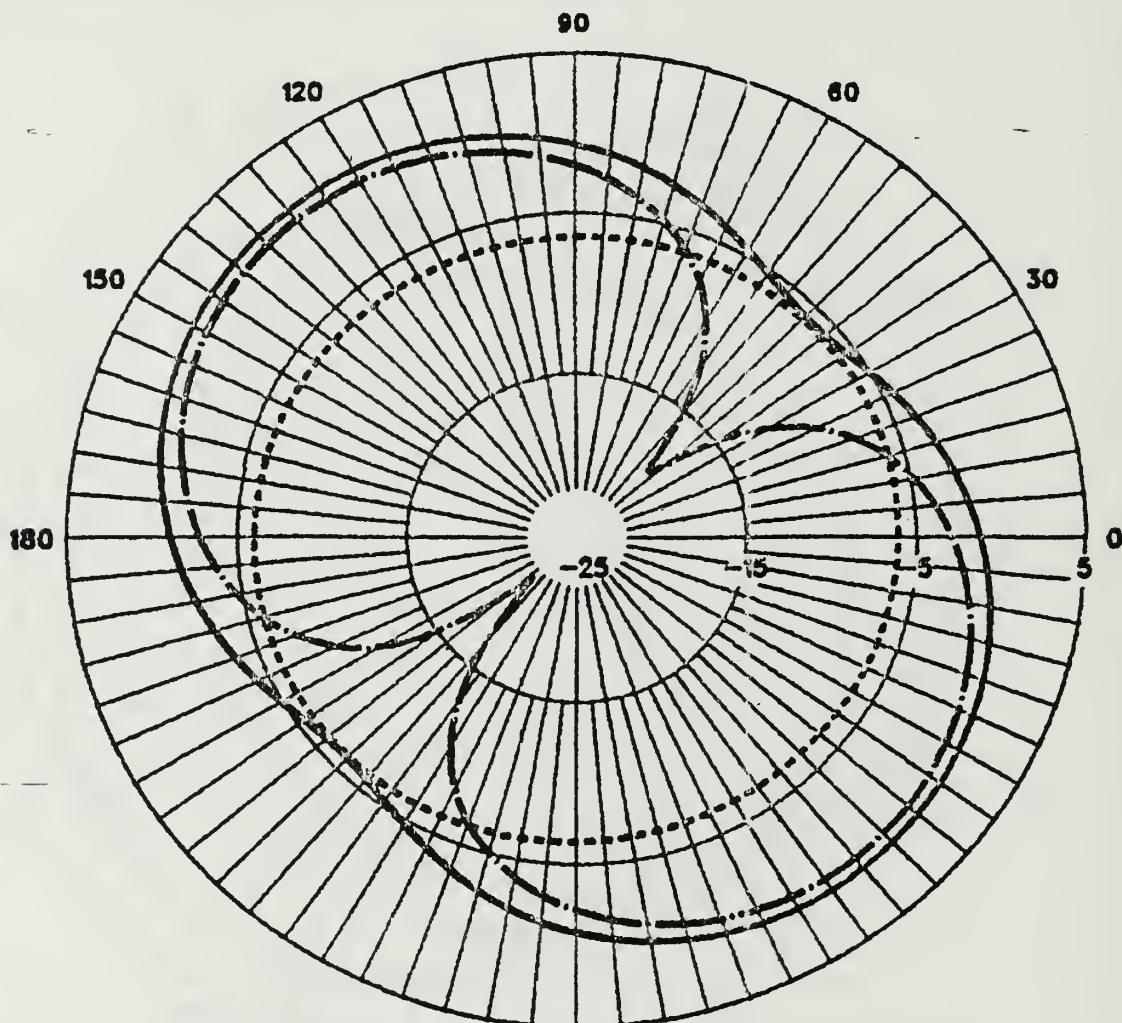
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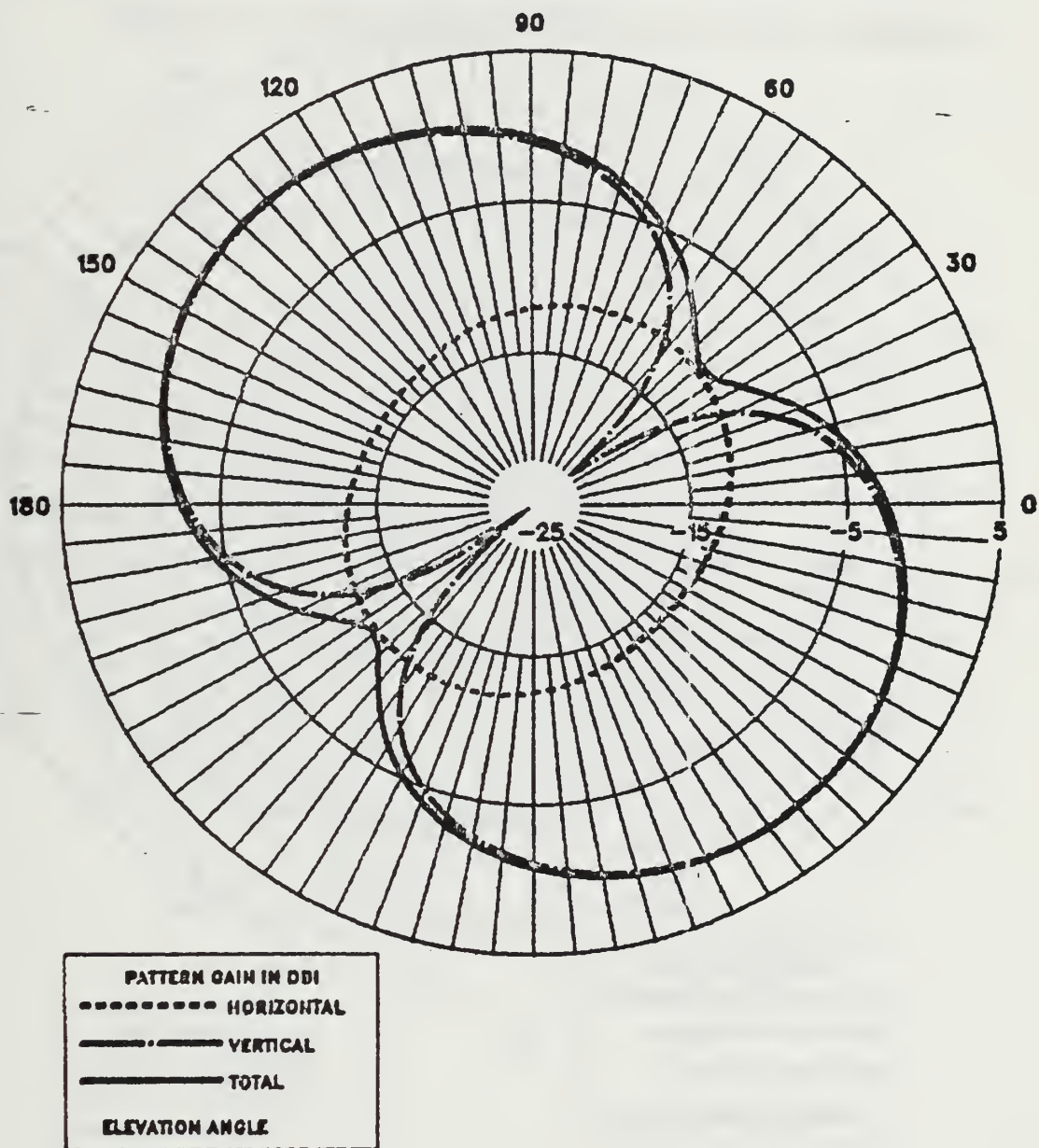
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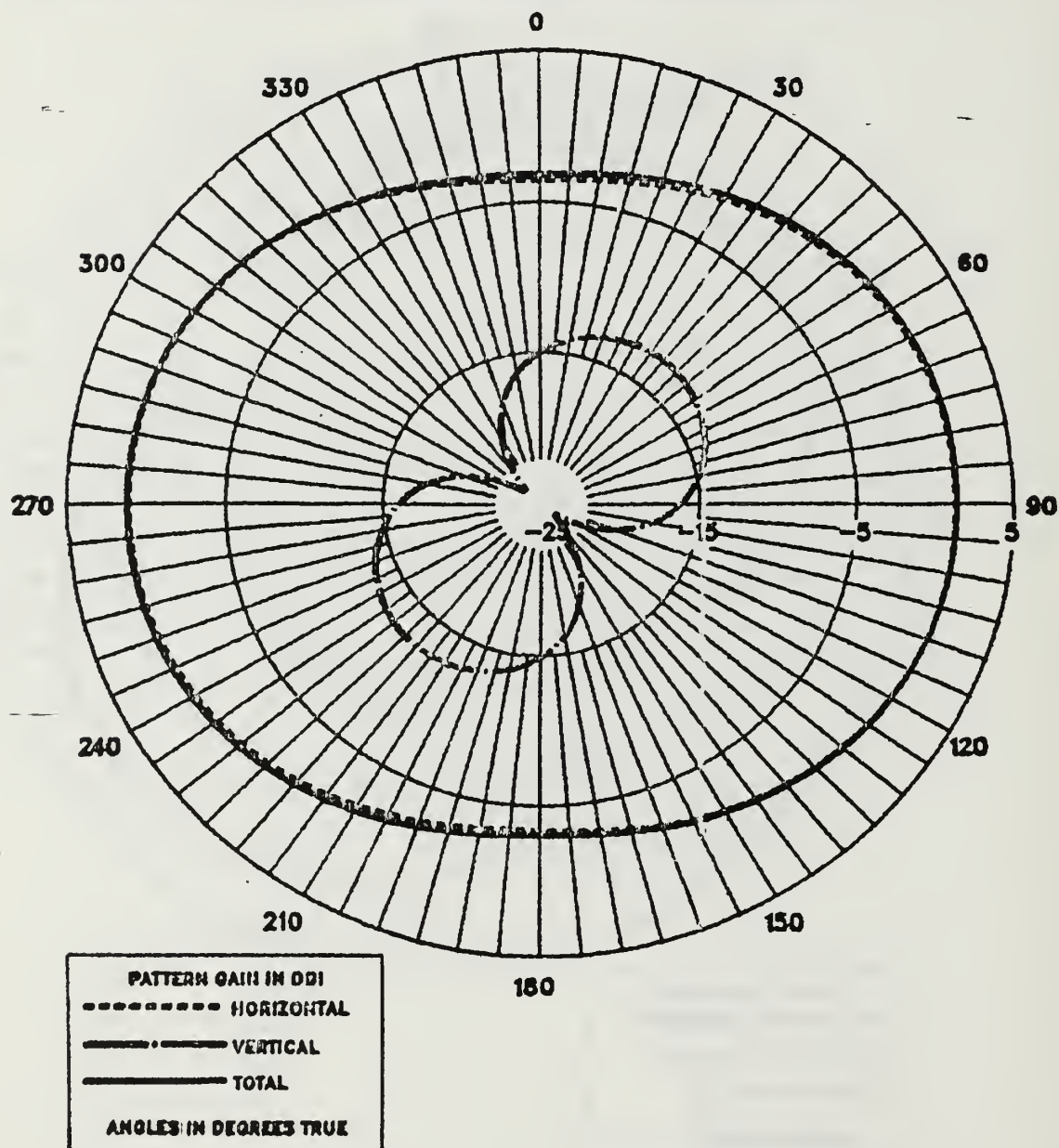
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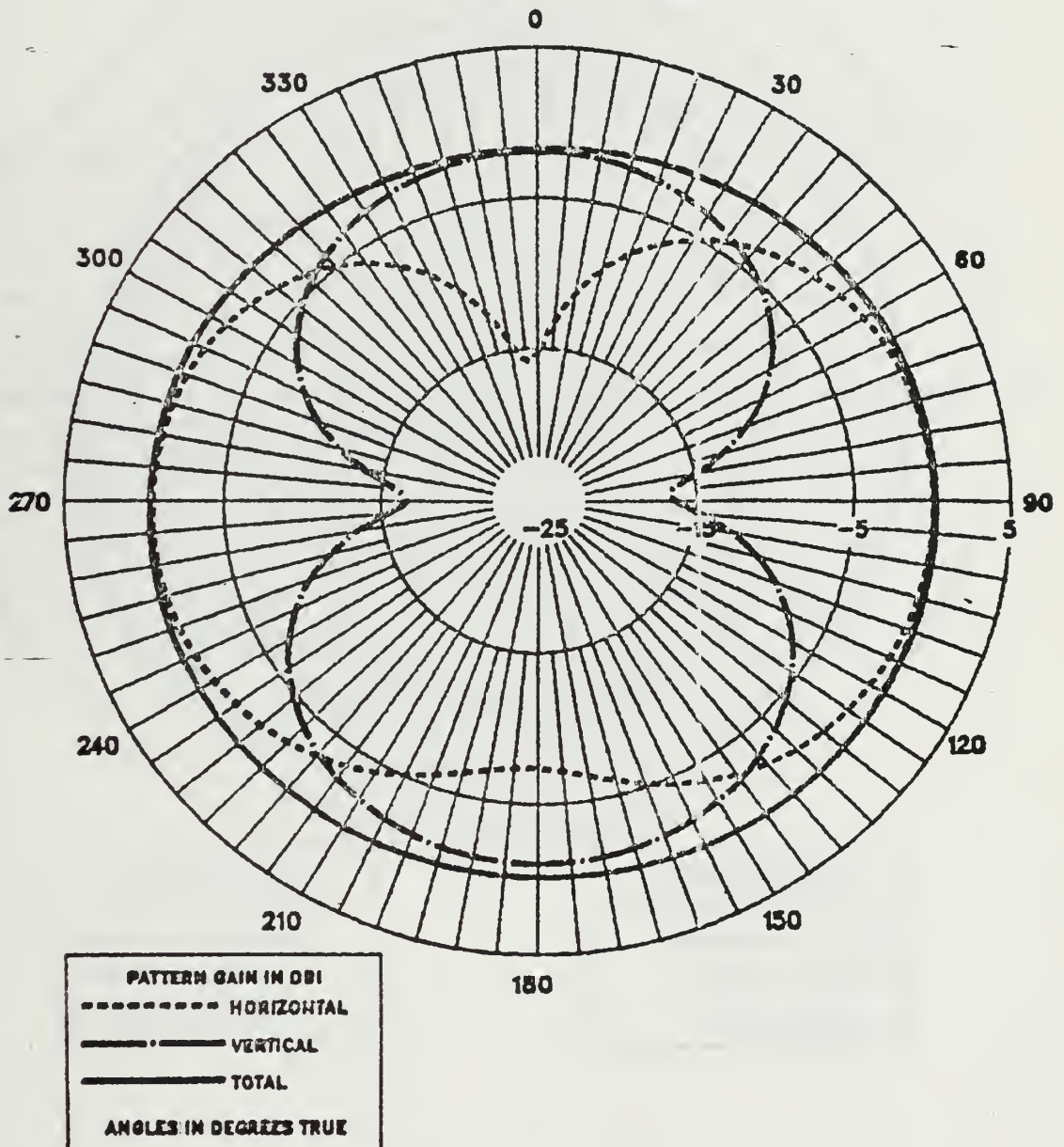
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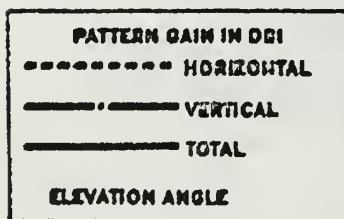
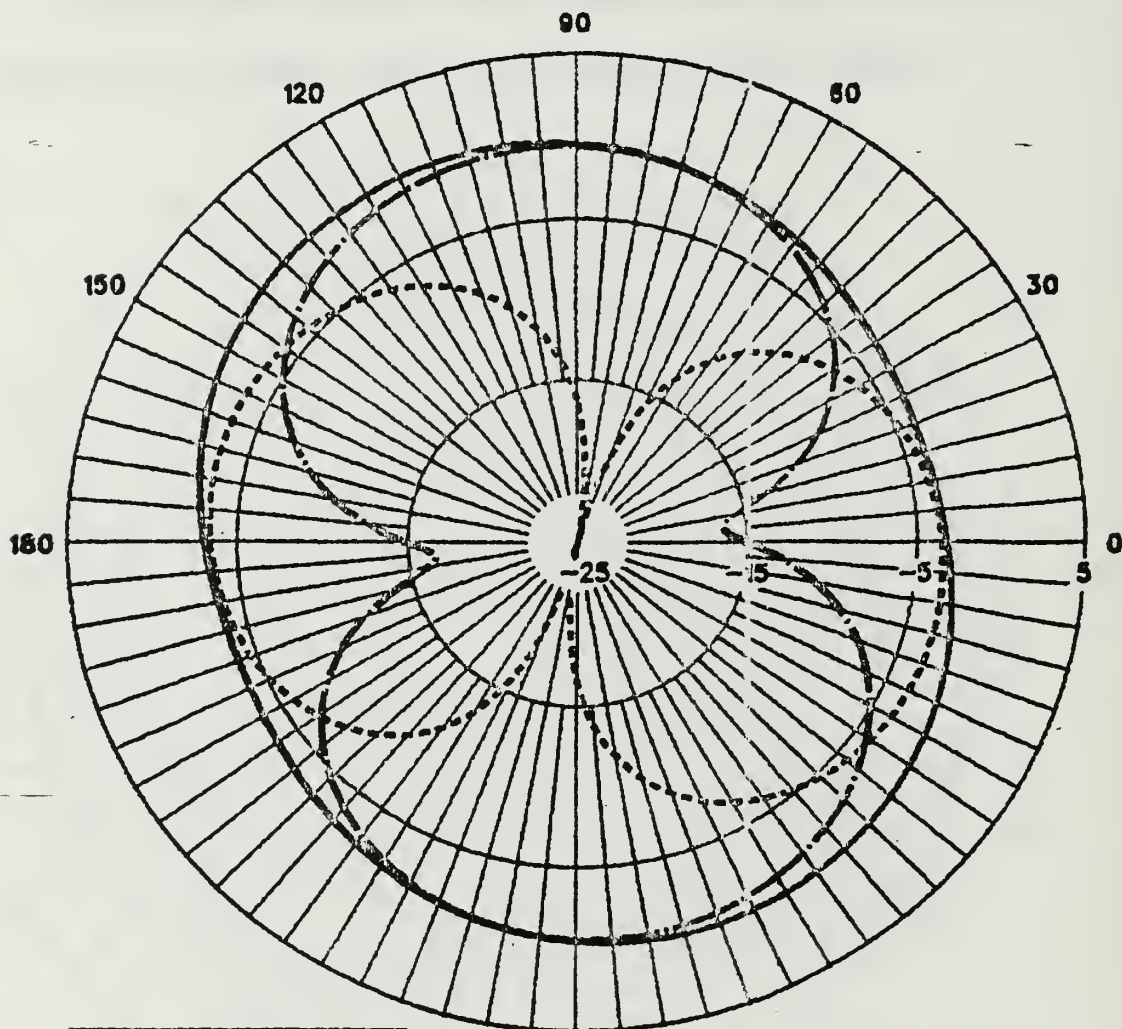
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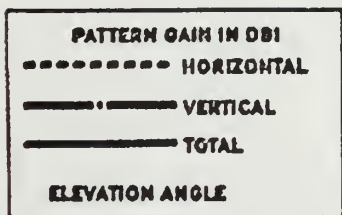
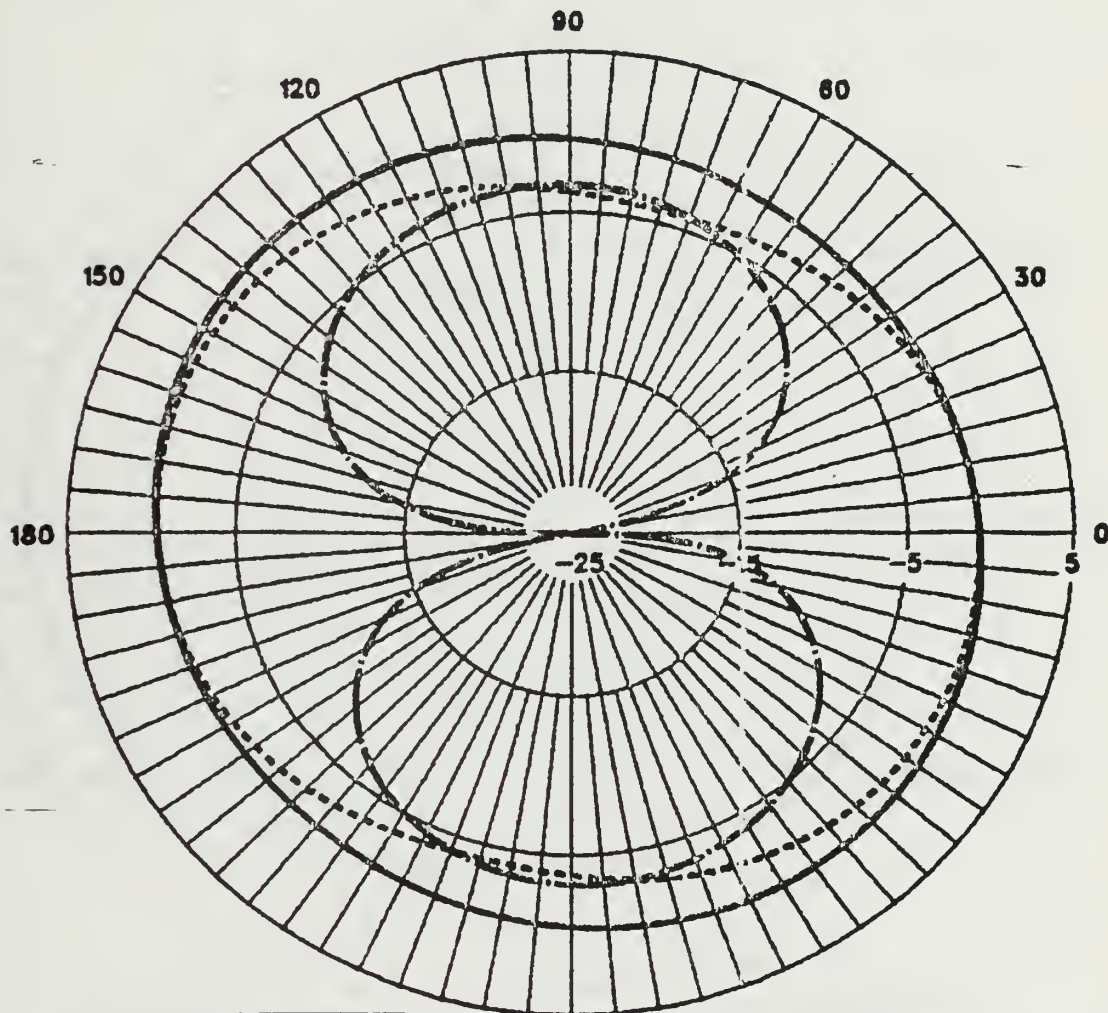
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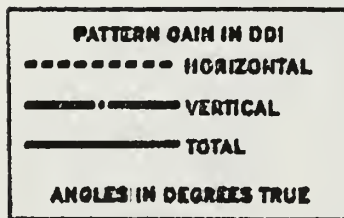
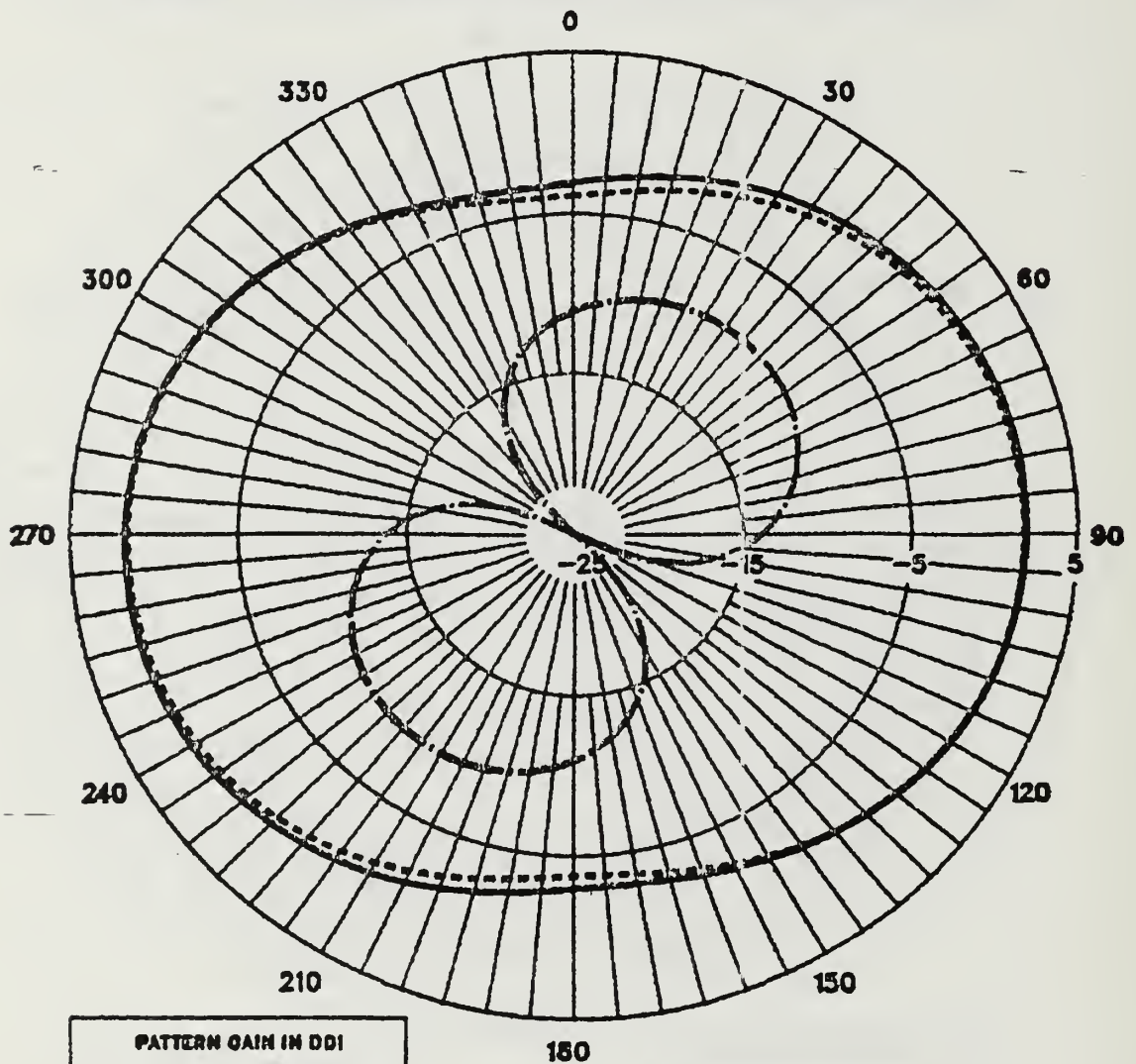
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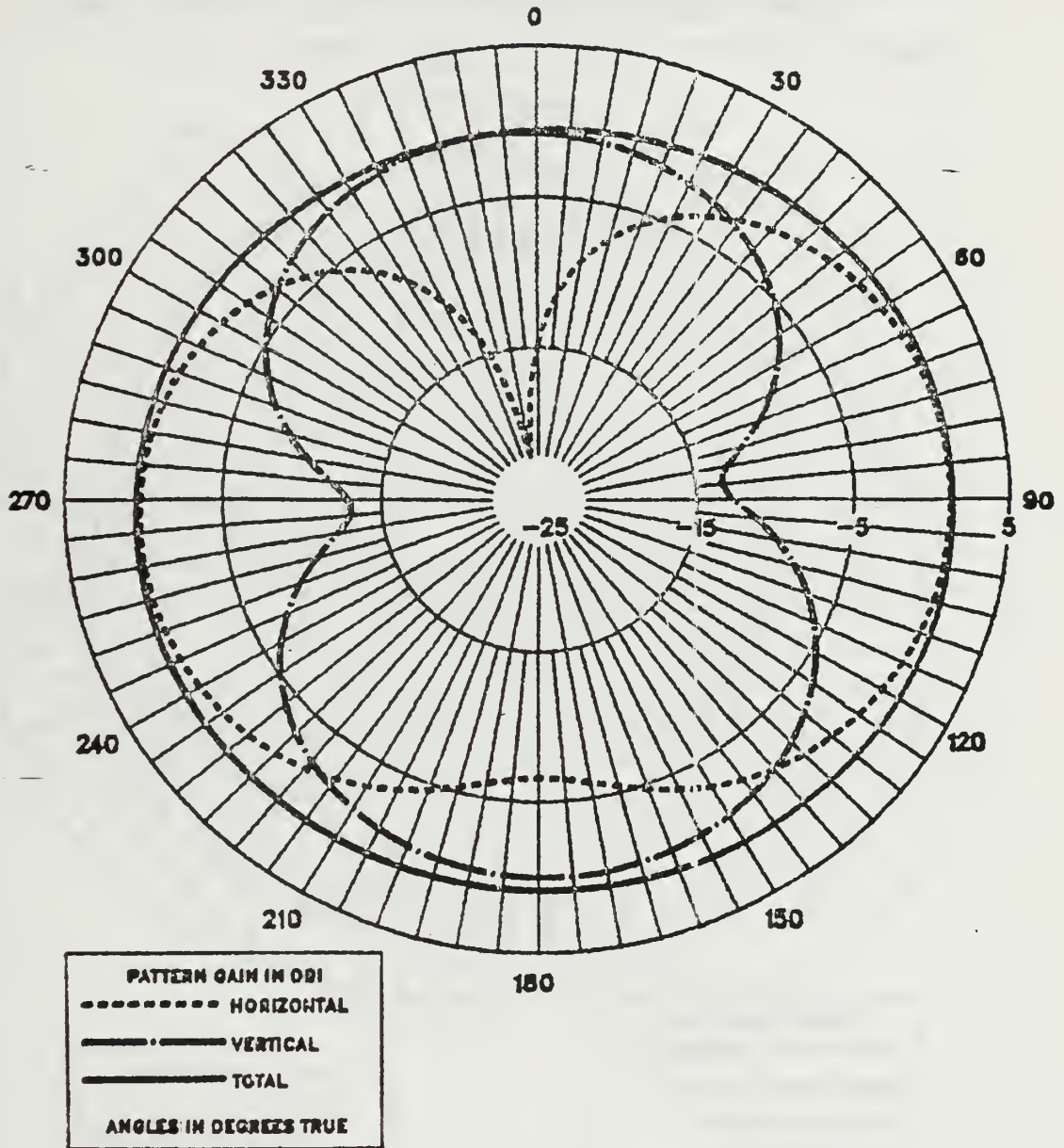
H65 IGUANA DATA RUN AT 4.040MHZ ON 8/15/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



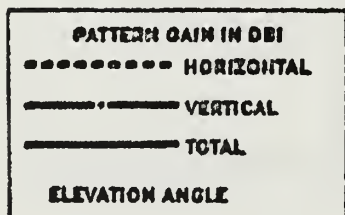
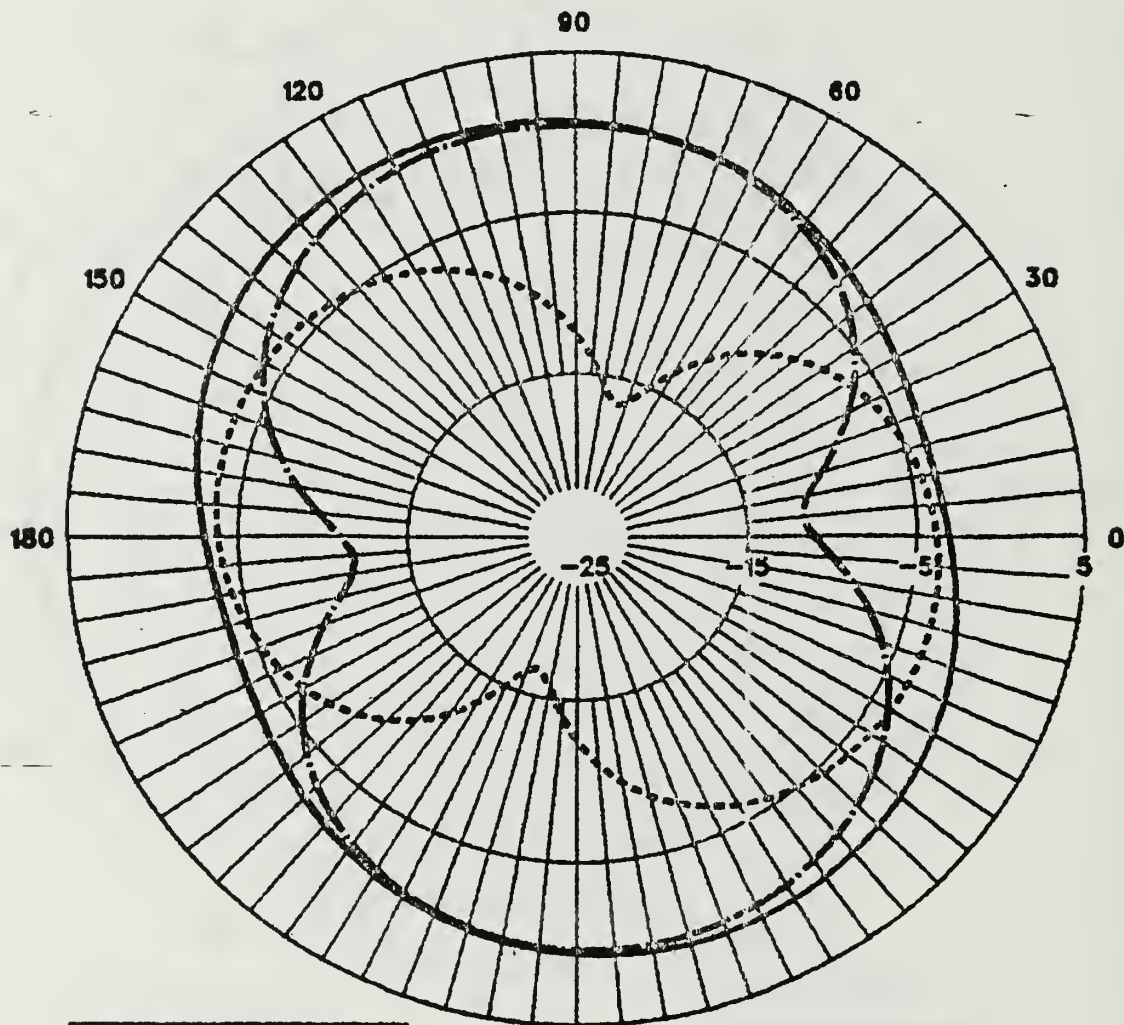
H65 IGUANA DATA RUN AT 4.040MHZ ON 8/15/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=26



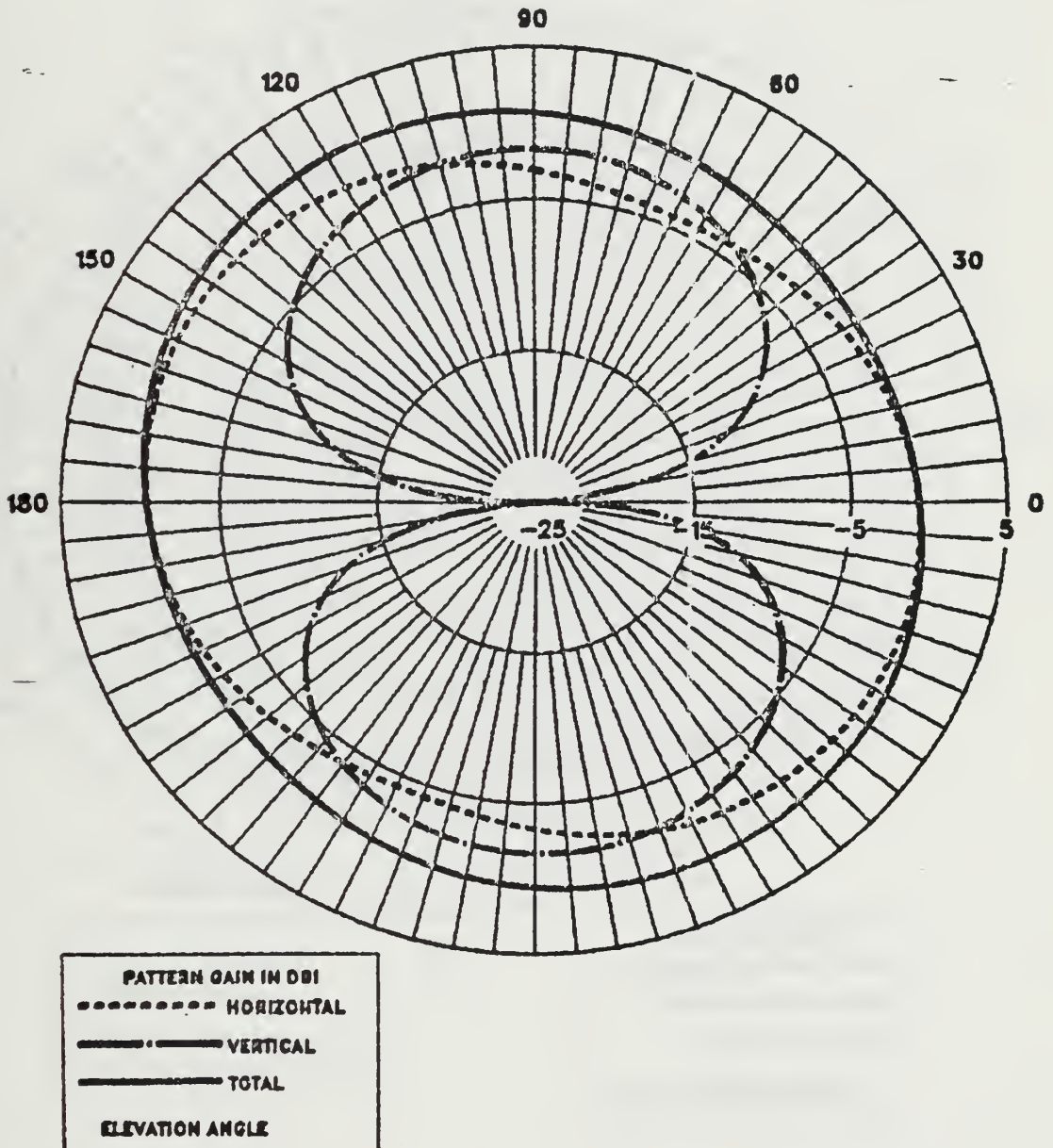
H65 IGUANA DATA RUN AT 4.040MHZ ON 8/15/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=0



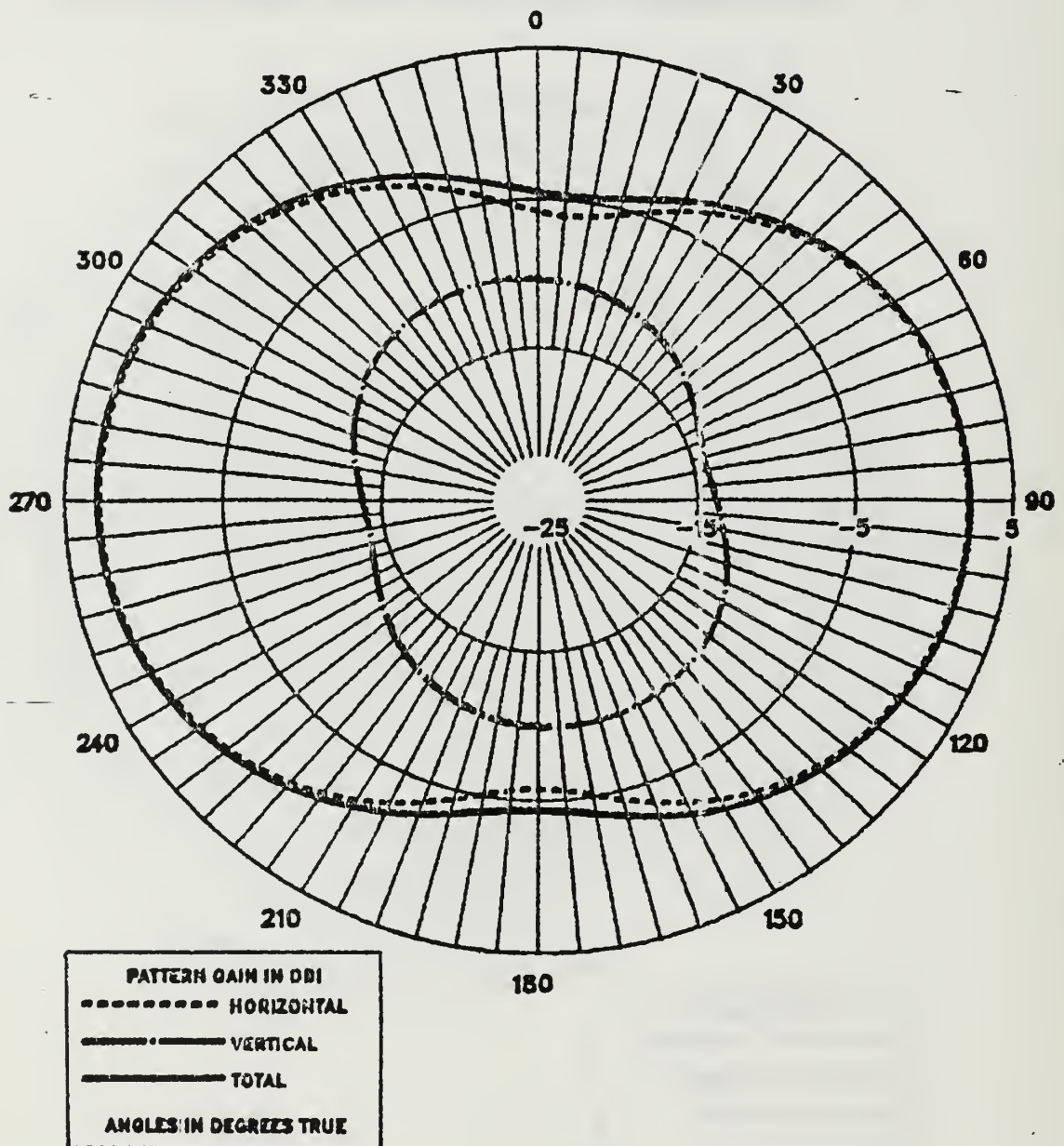
H65 IGUANA DATA RUN AT 4.040MHZ ON 8/15/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=45



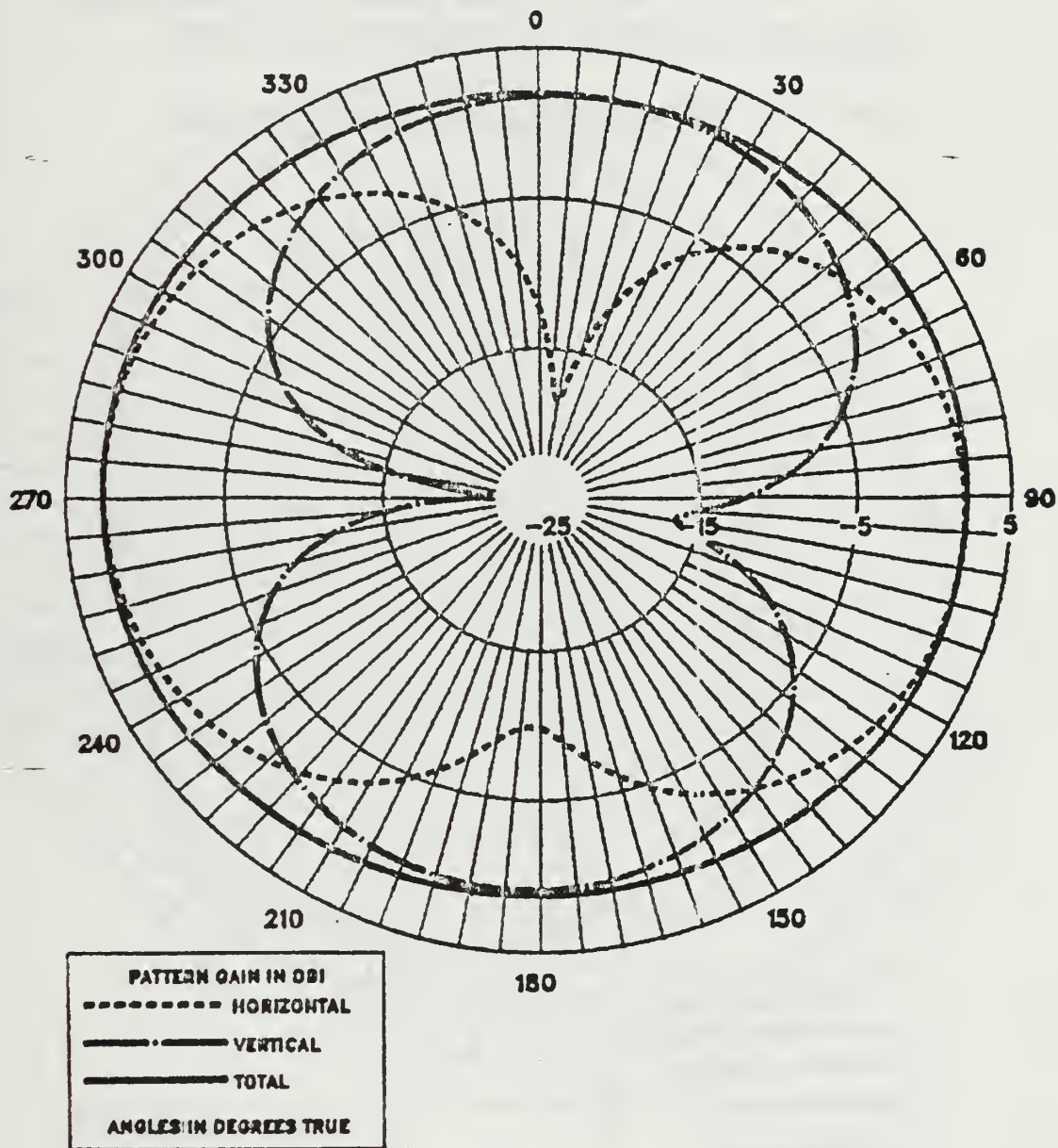
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



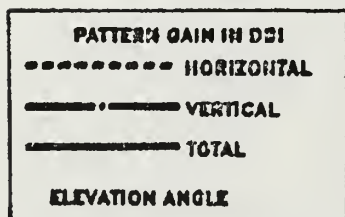
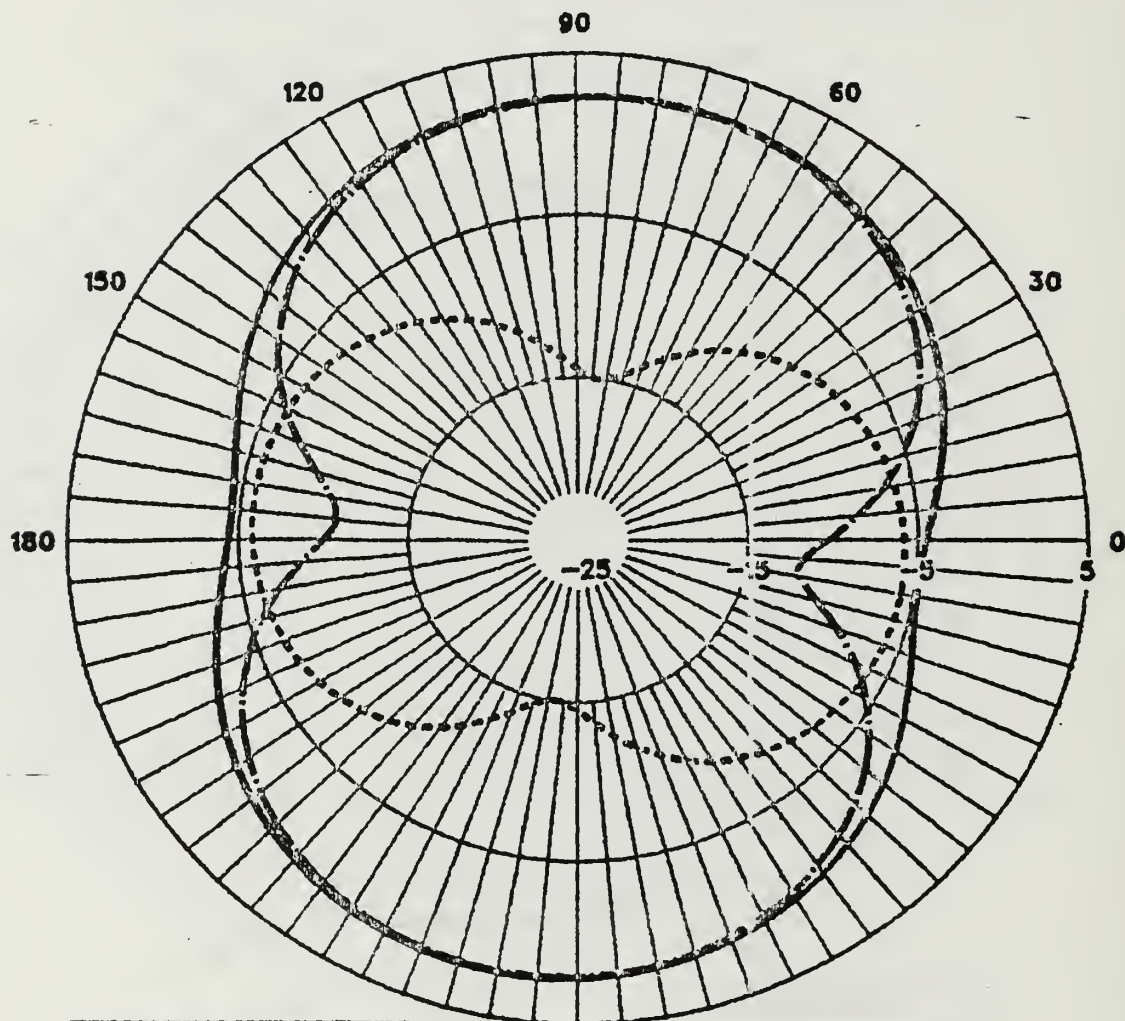
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



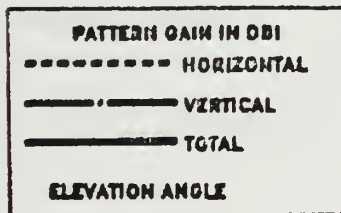
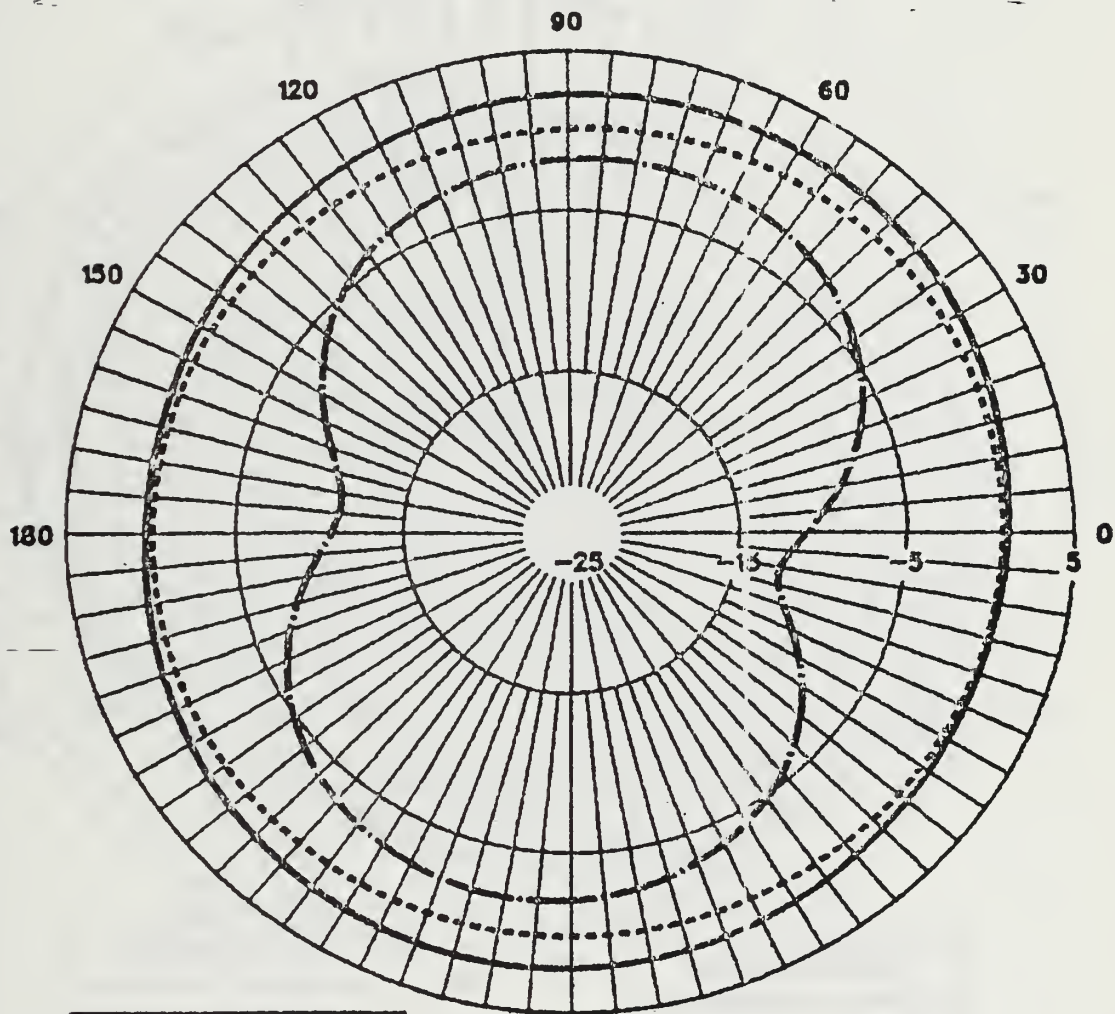
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LONG-WIRE ANT, FREE SPACE, VERT CUT, $\Phi=0$



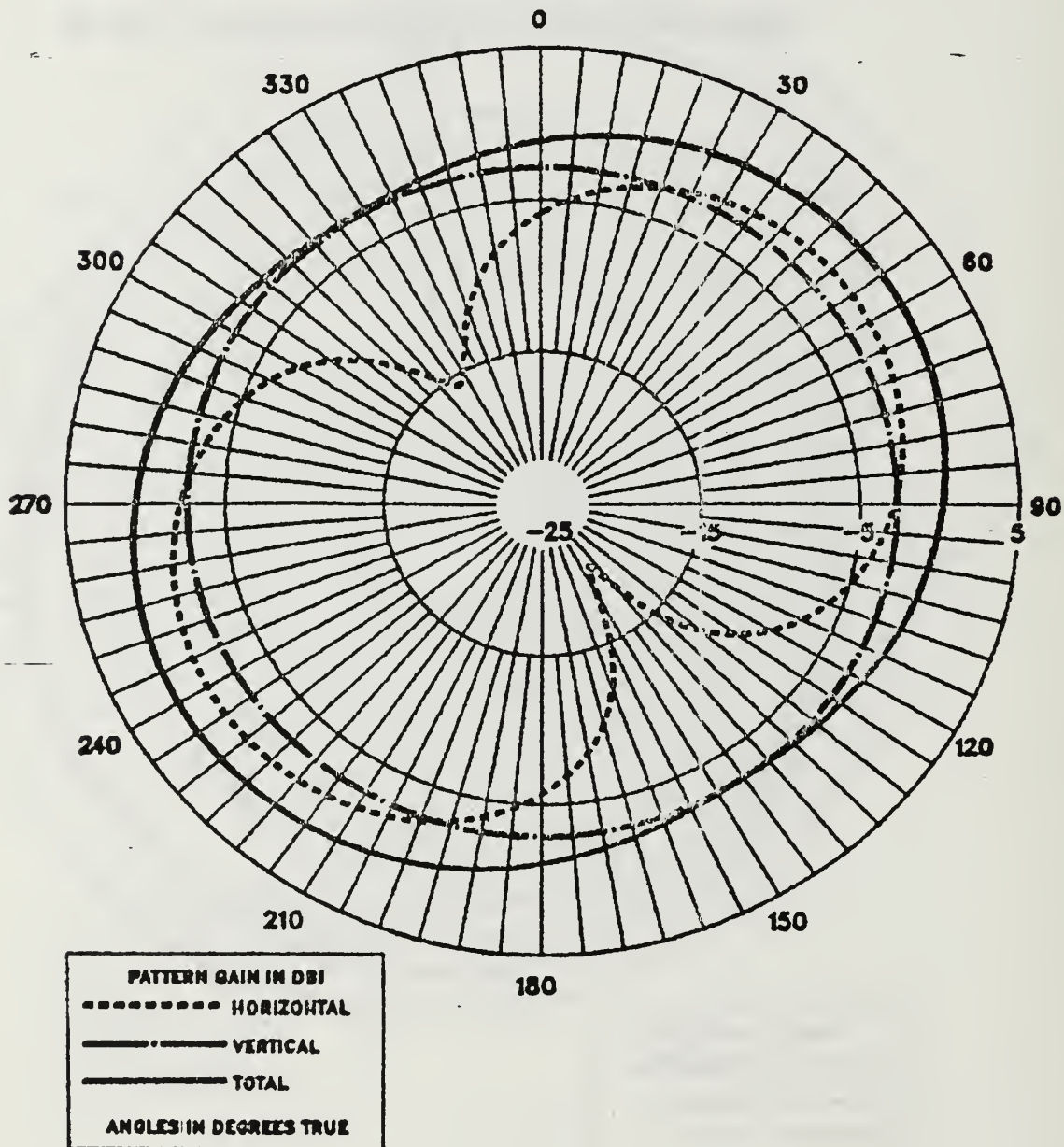
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



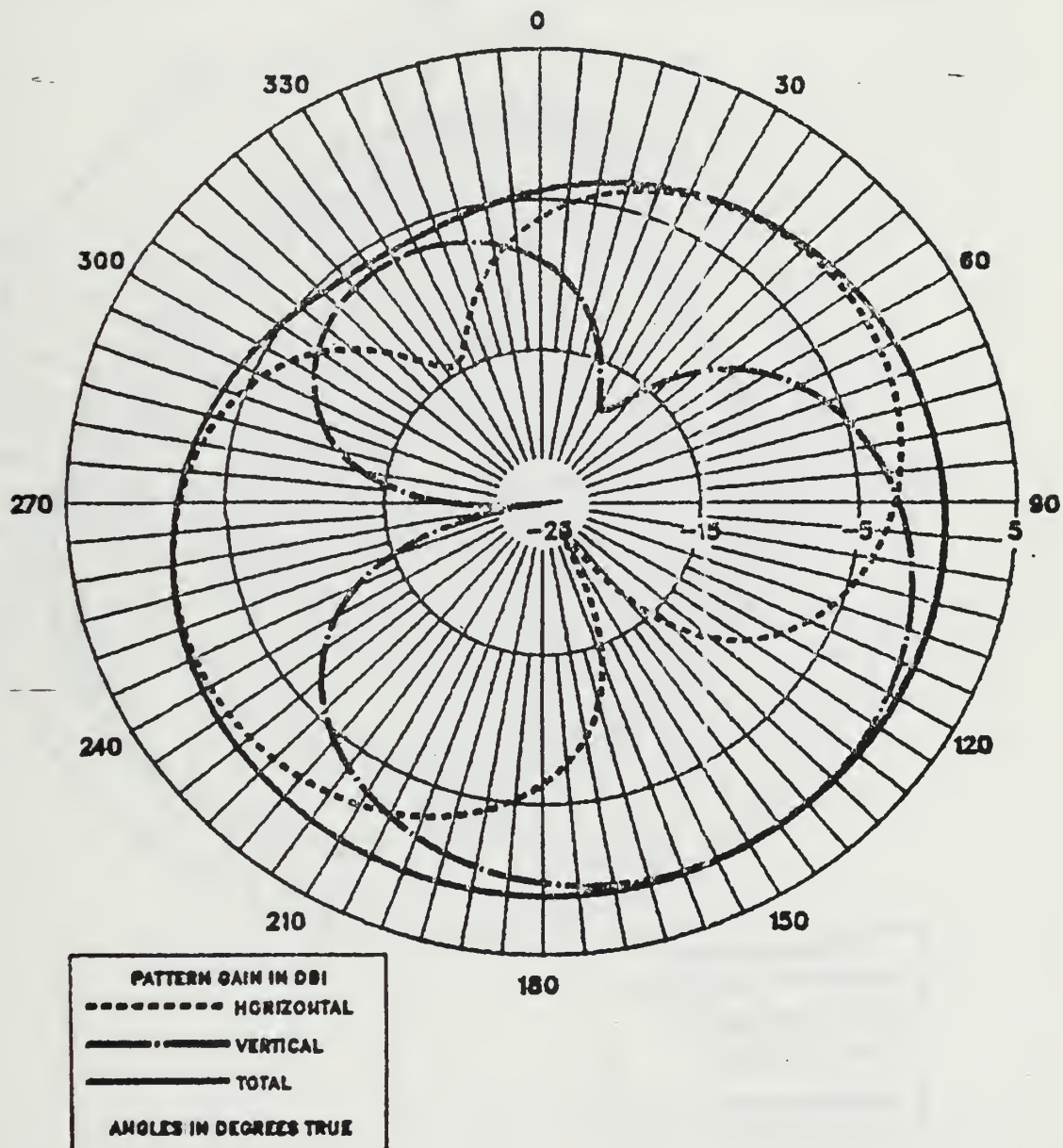
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COLLINS 437R-2, FREE SPACE, HORIZ CUT, THETA=90



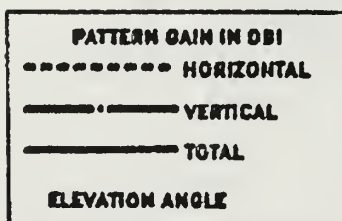
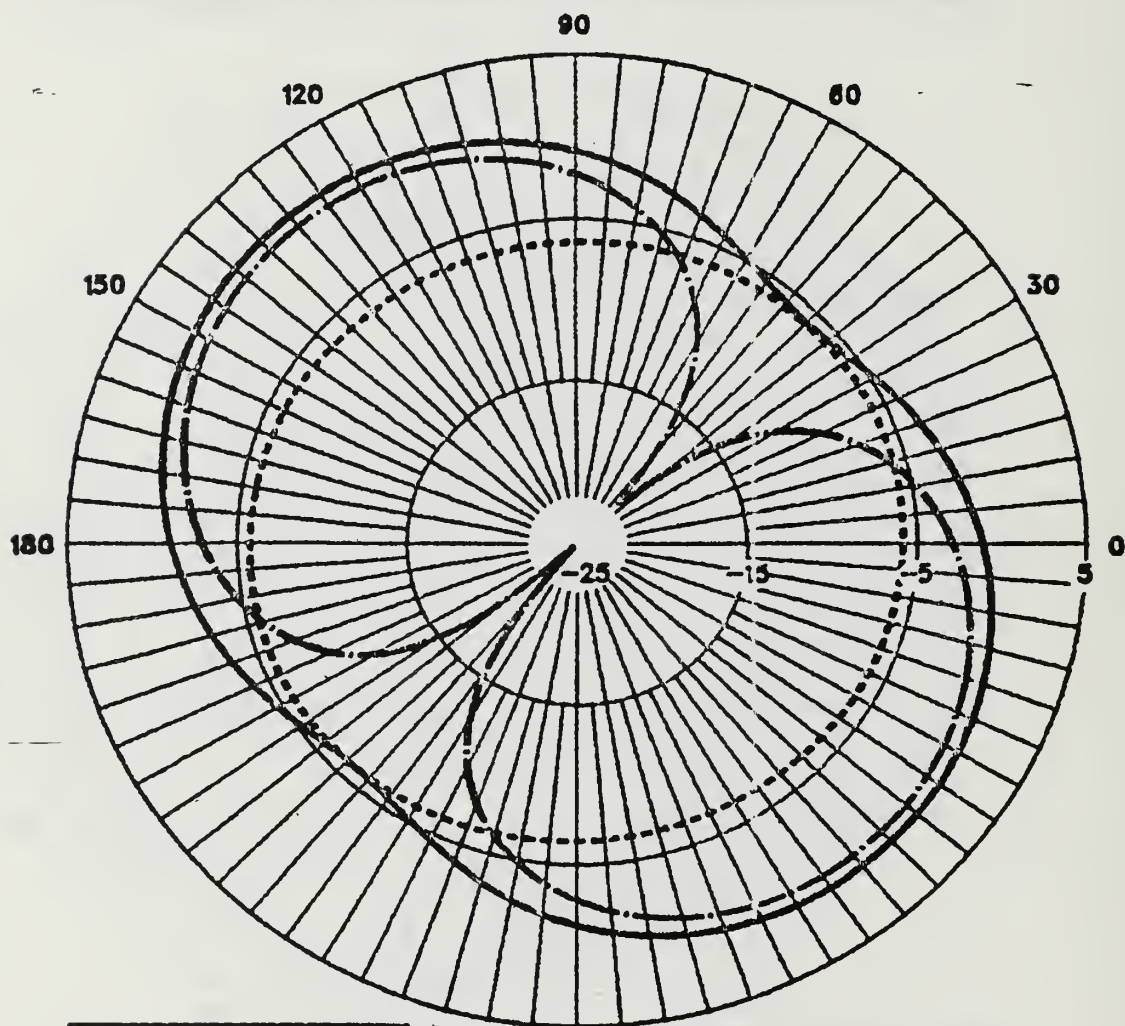
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COLLINS 437R-2, FREE SPACE, HORIZ CUT, THETA=26



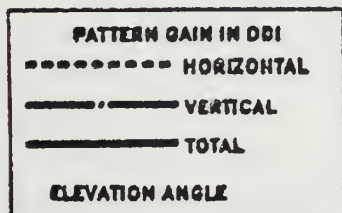
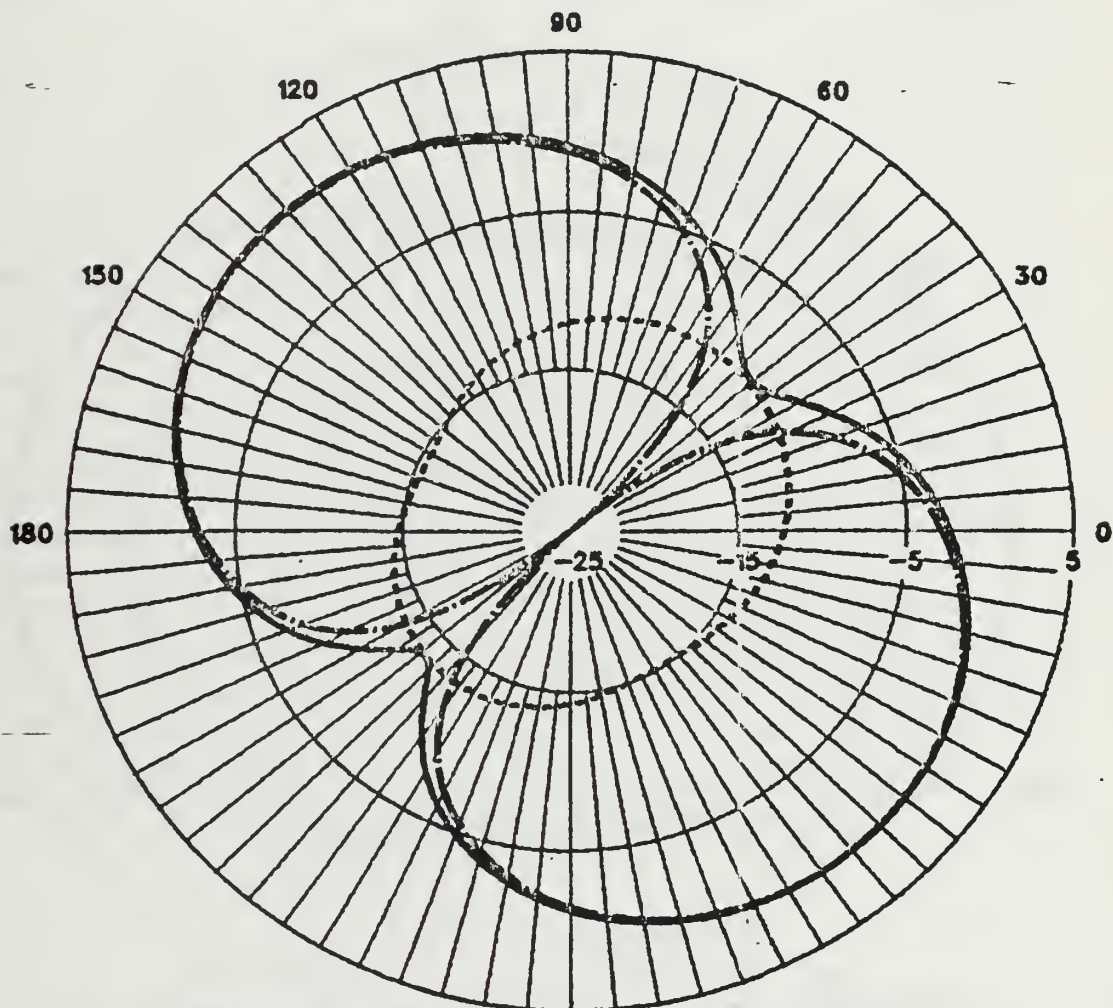
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COLLINS 437R-2, FREE SPACE, VERT CUT, PHI=0



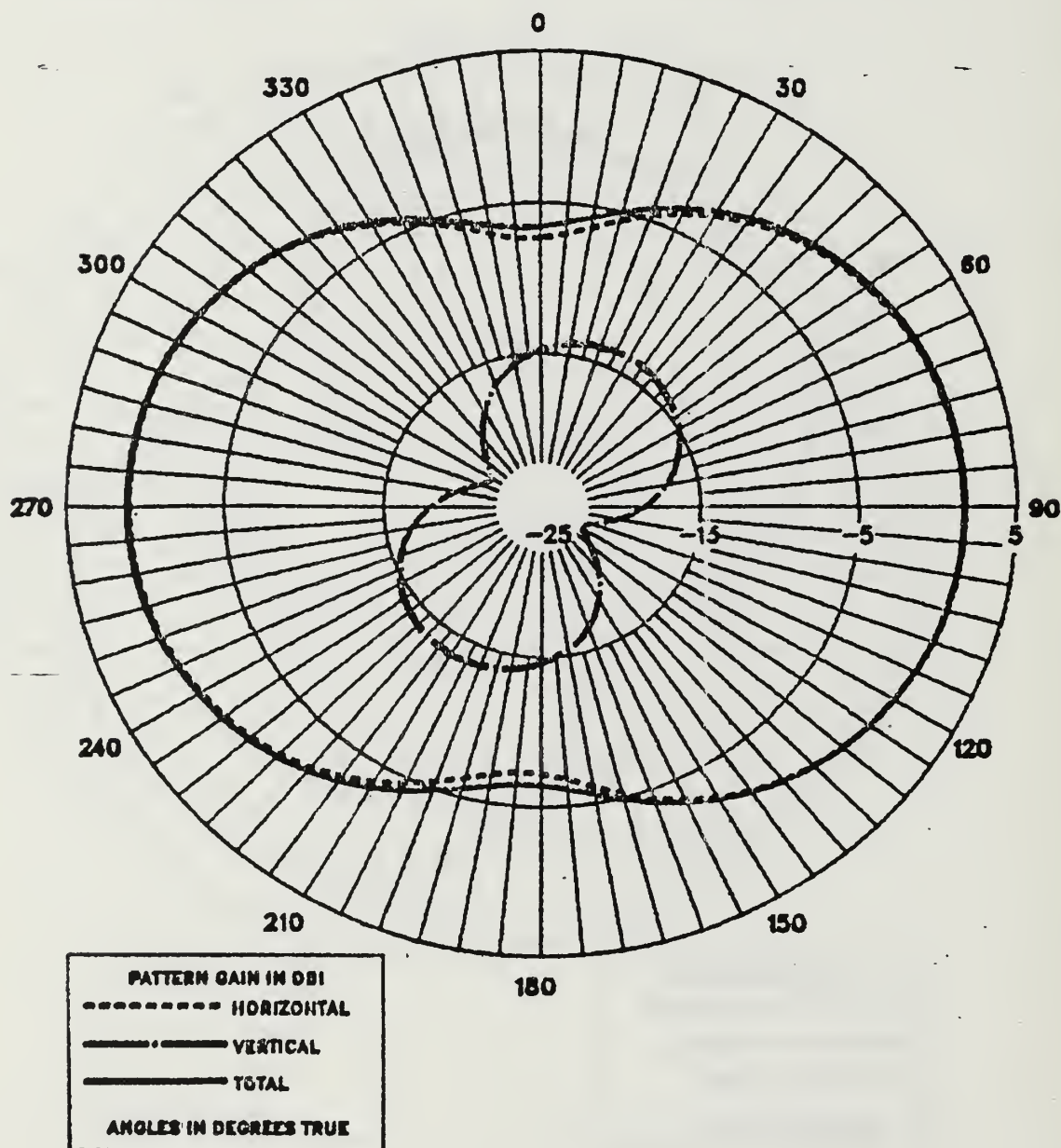
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COLLINS 437R-2, FREE SPACE, VERT CUT, PHI=45



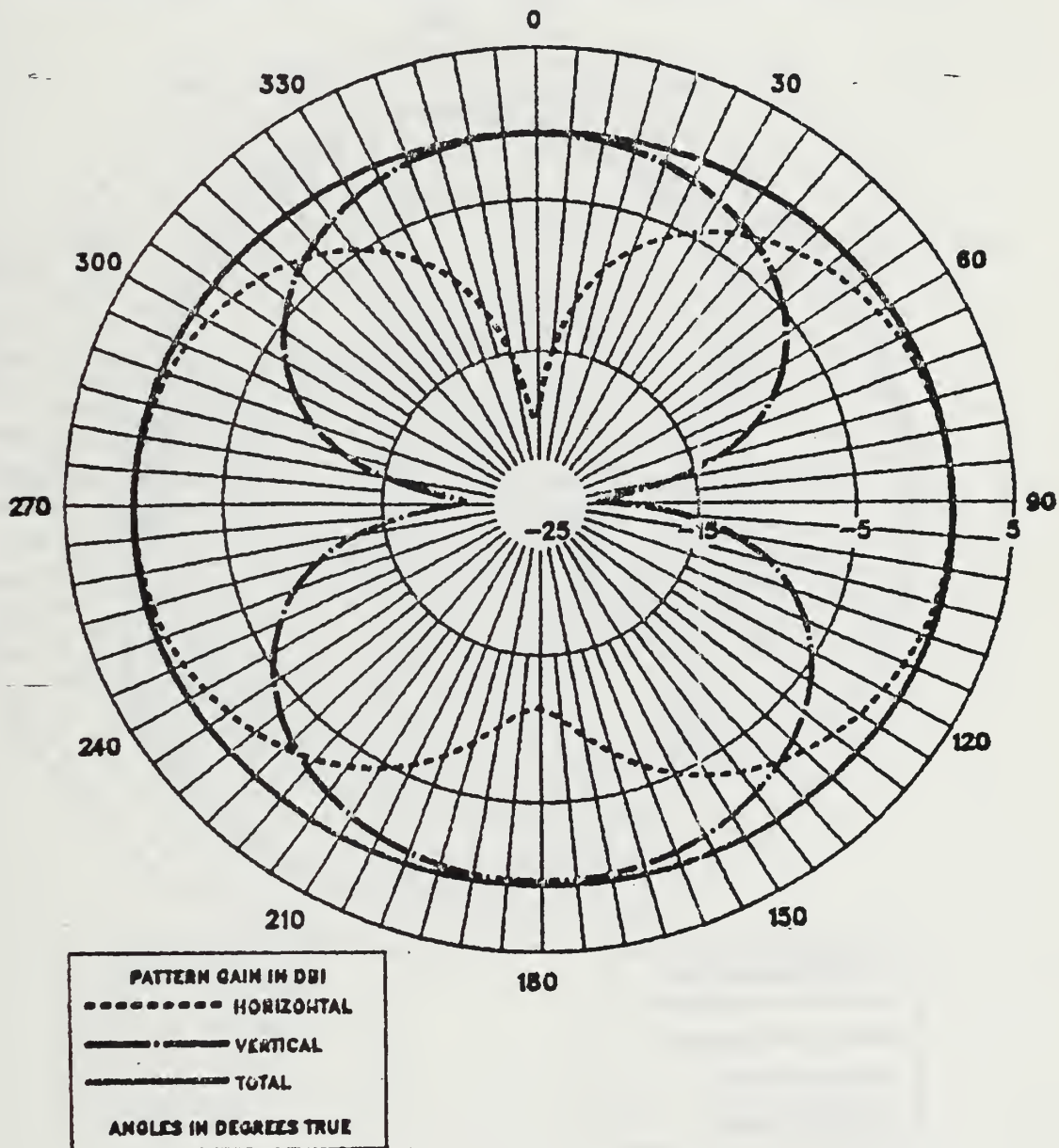
H65 IGUANA DATA RUN AT 5.696MHZ. ON 8/20/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



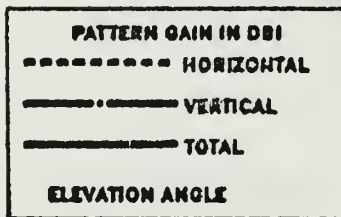
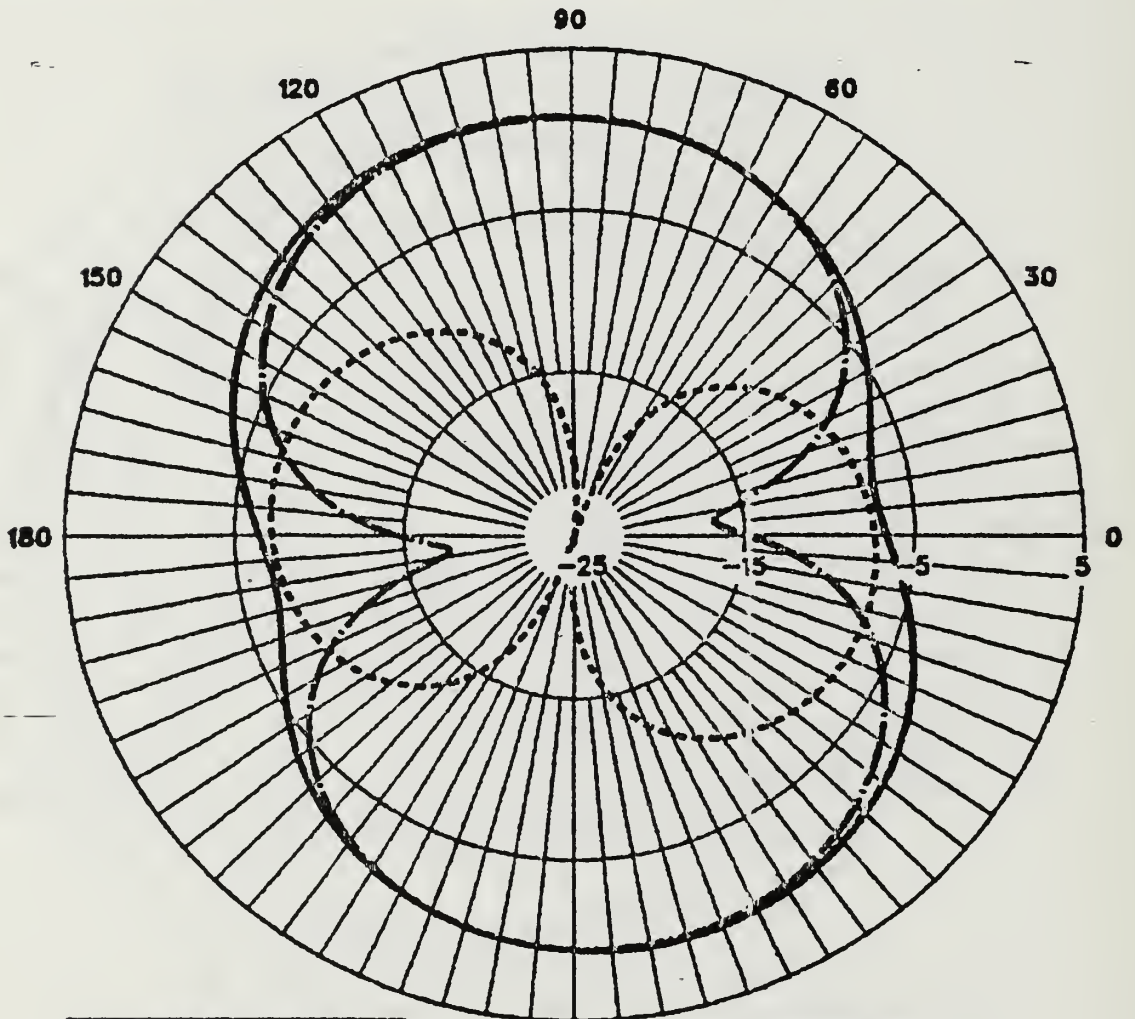
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



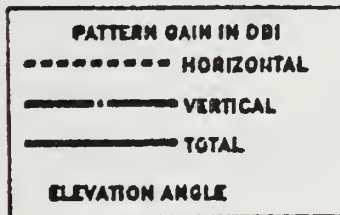
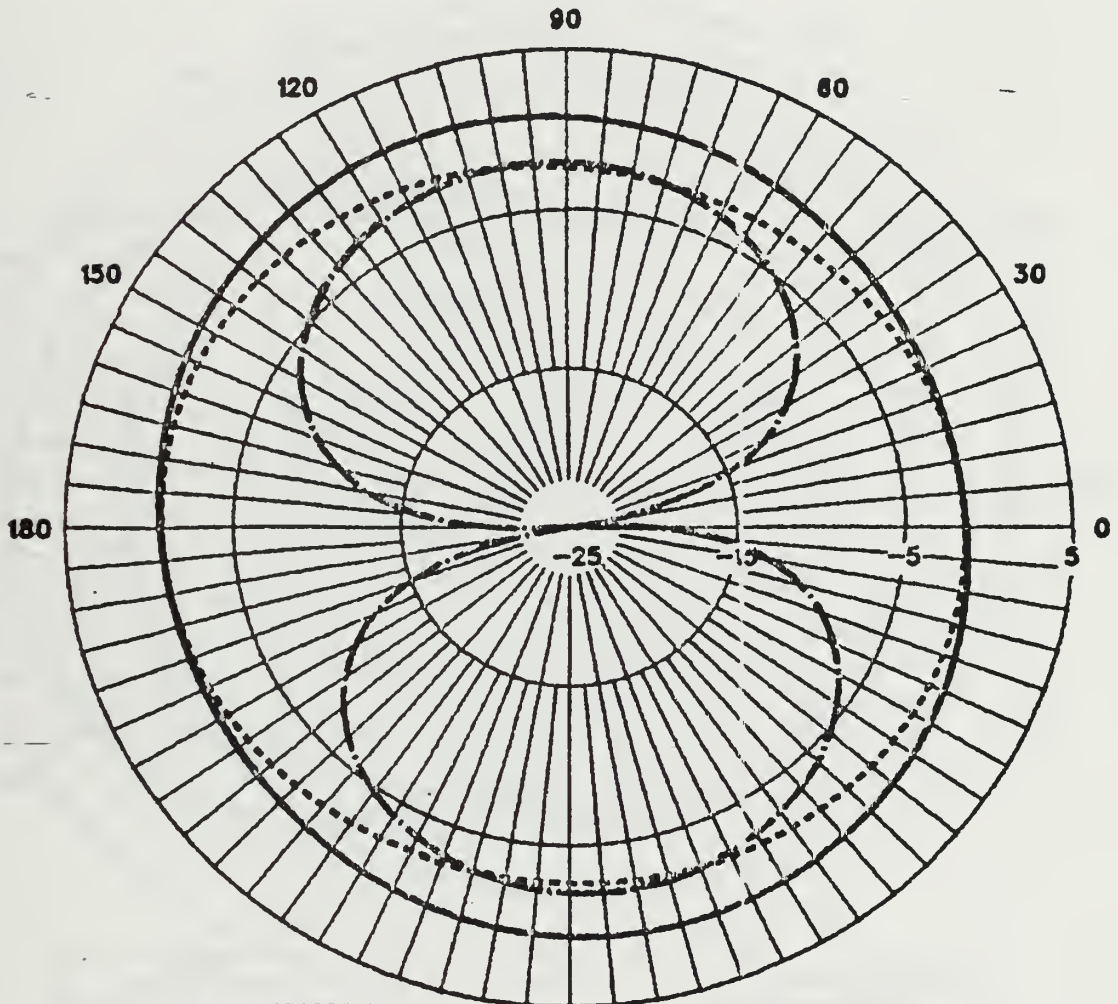
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



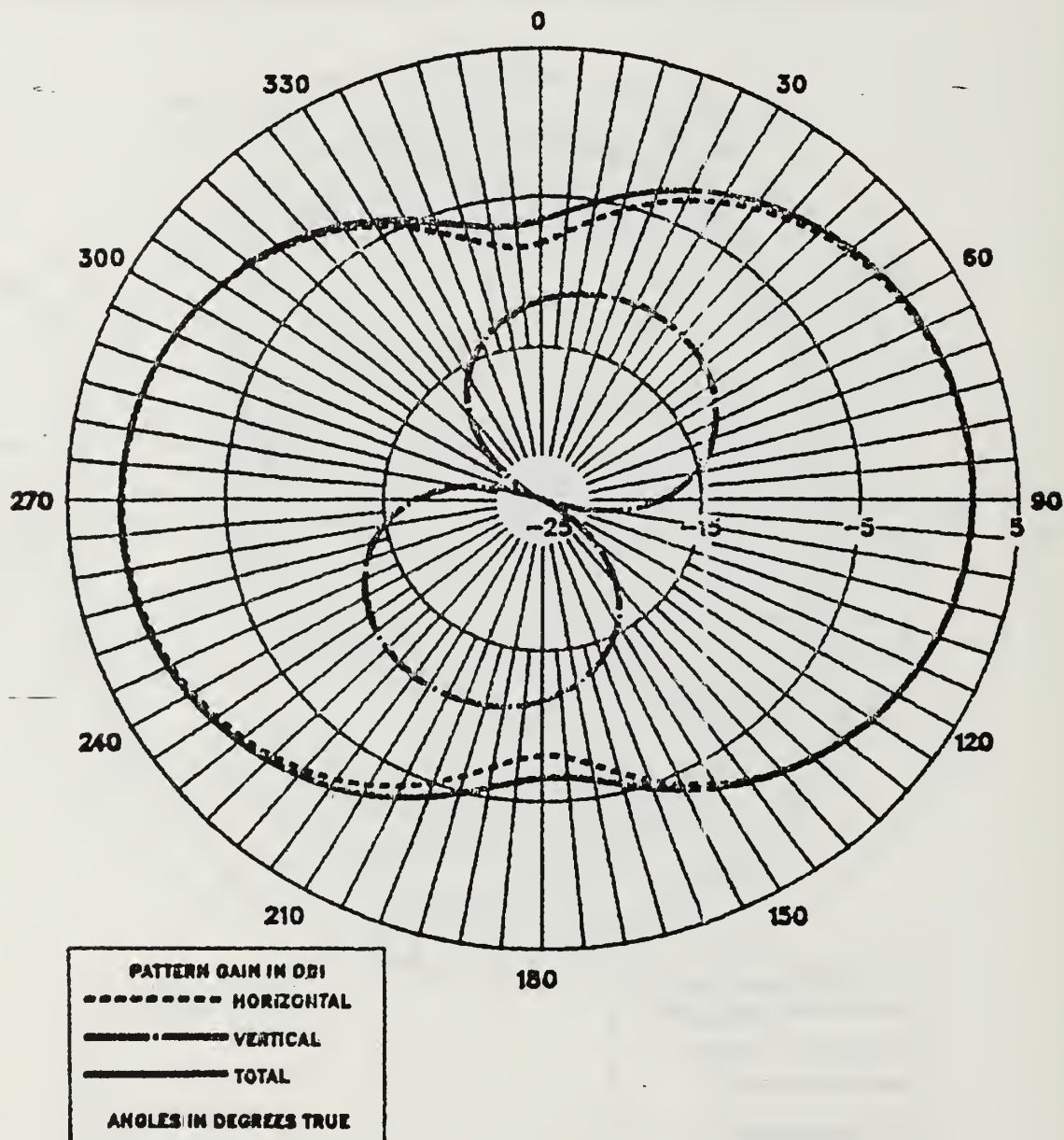
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



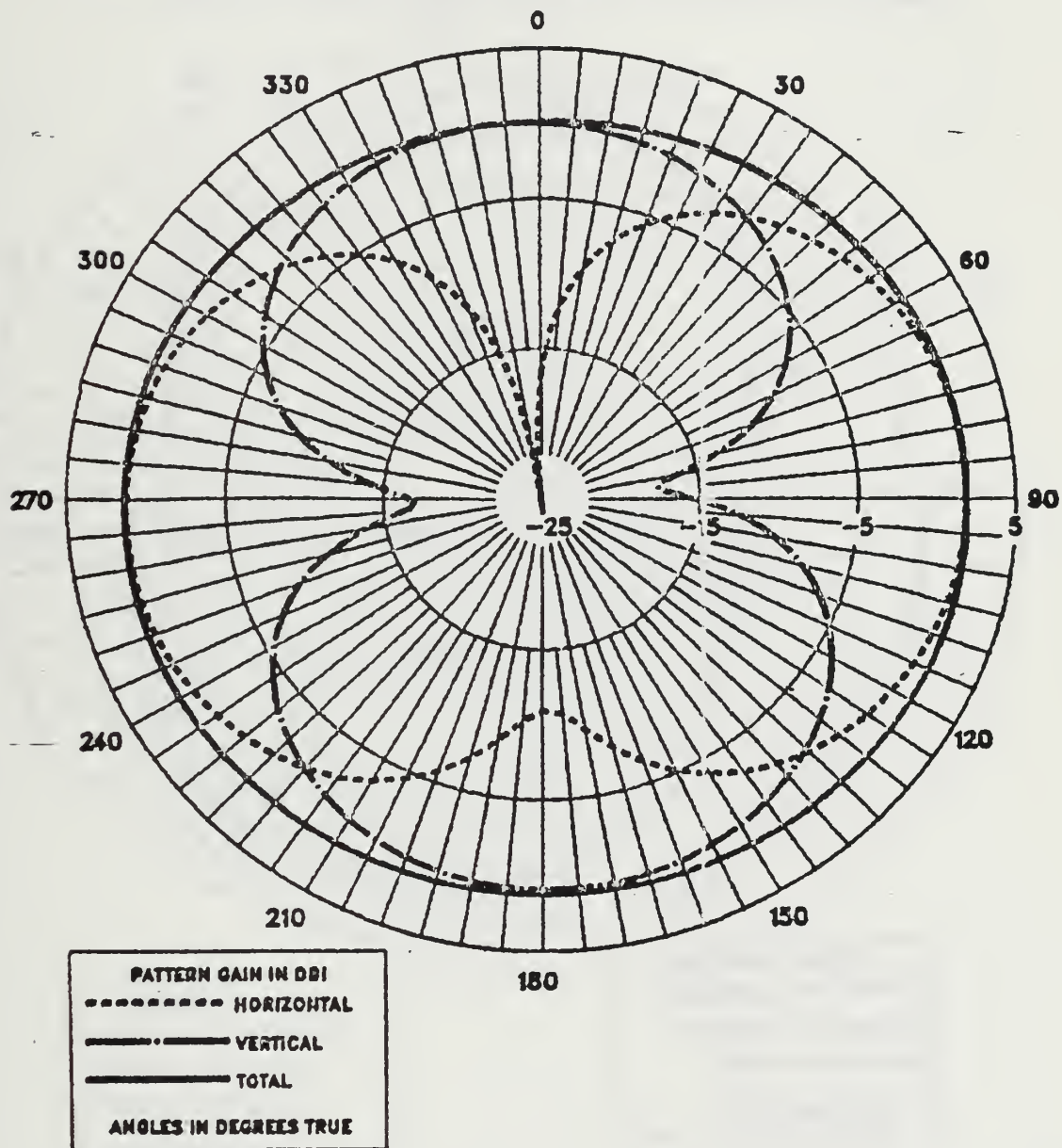
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



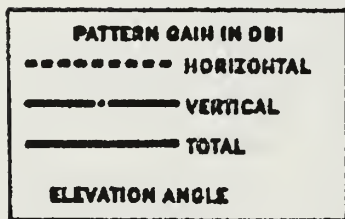
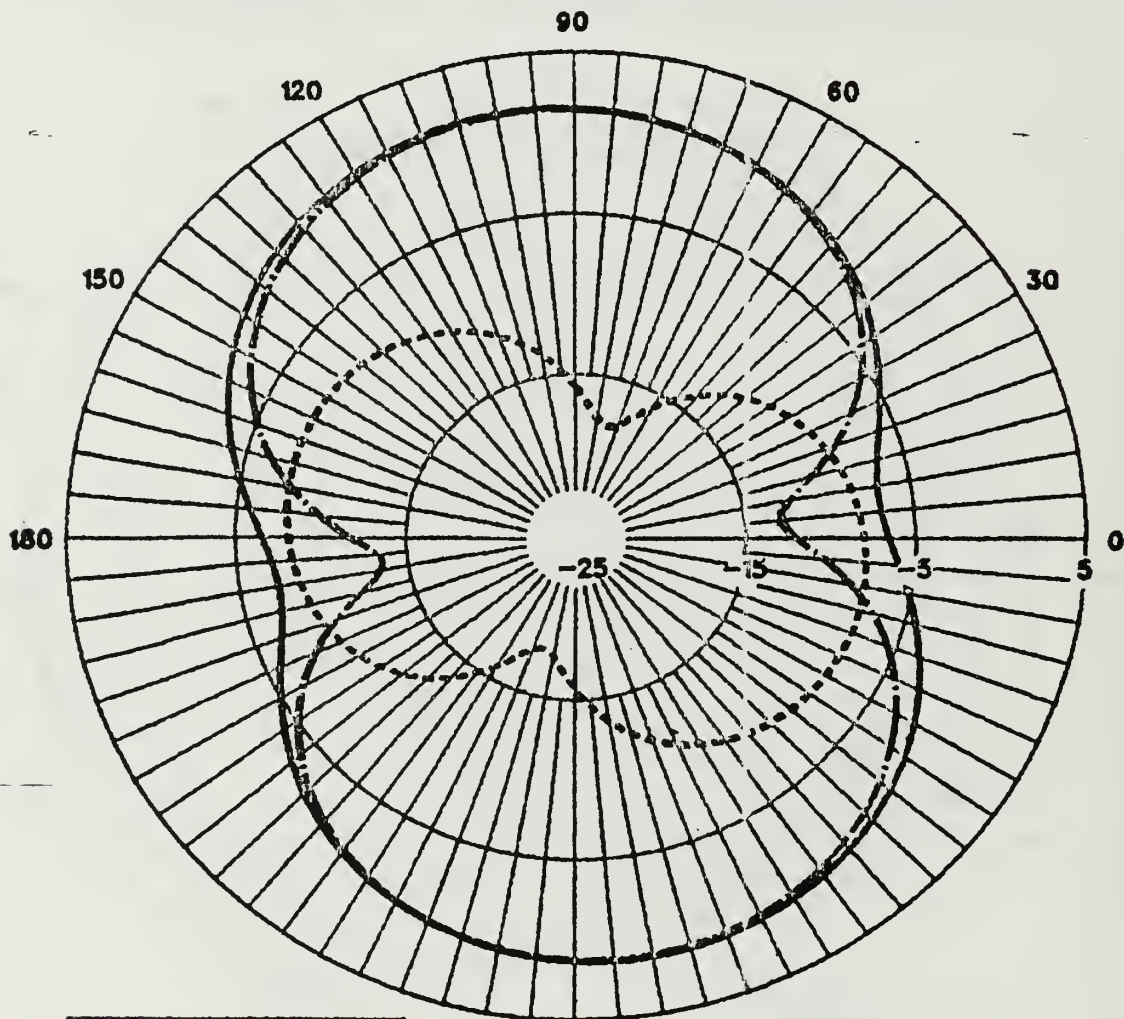
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=26



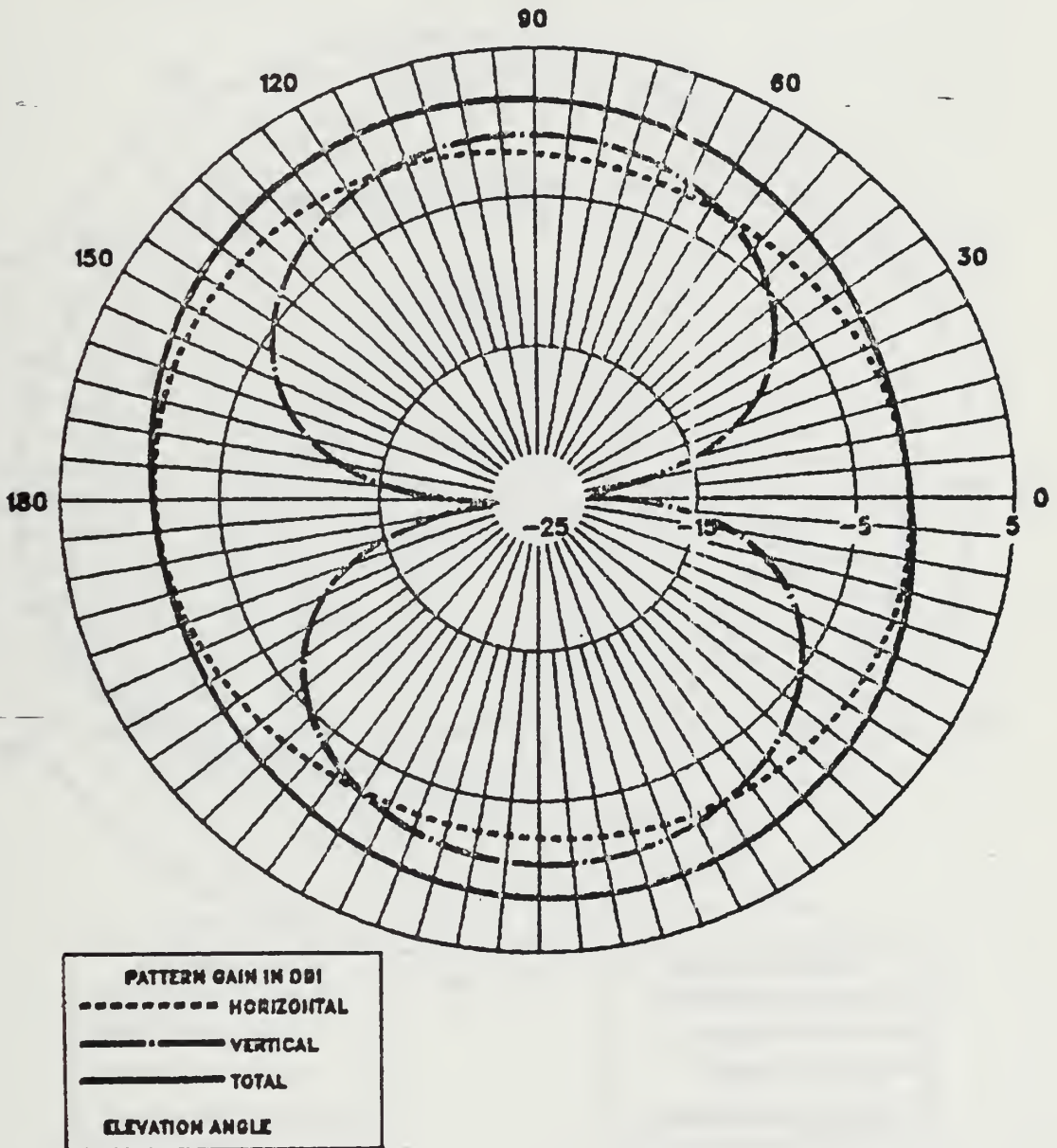
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=0



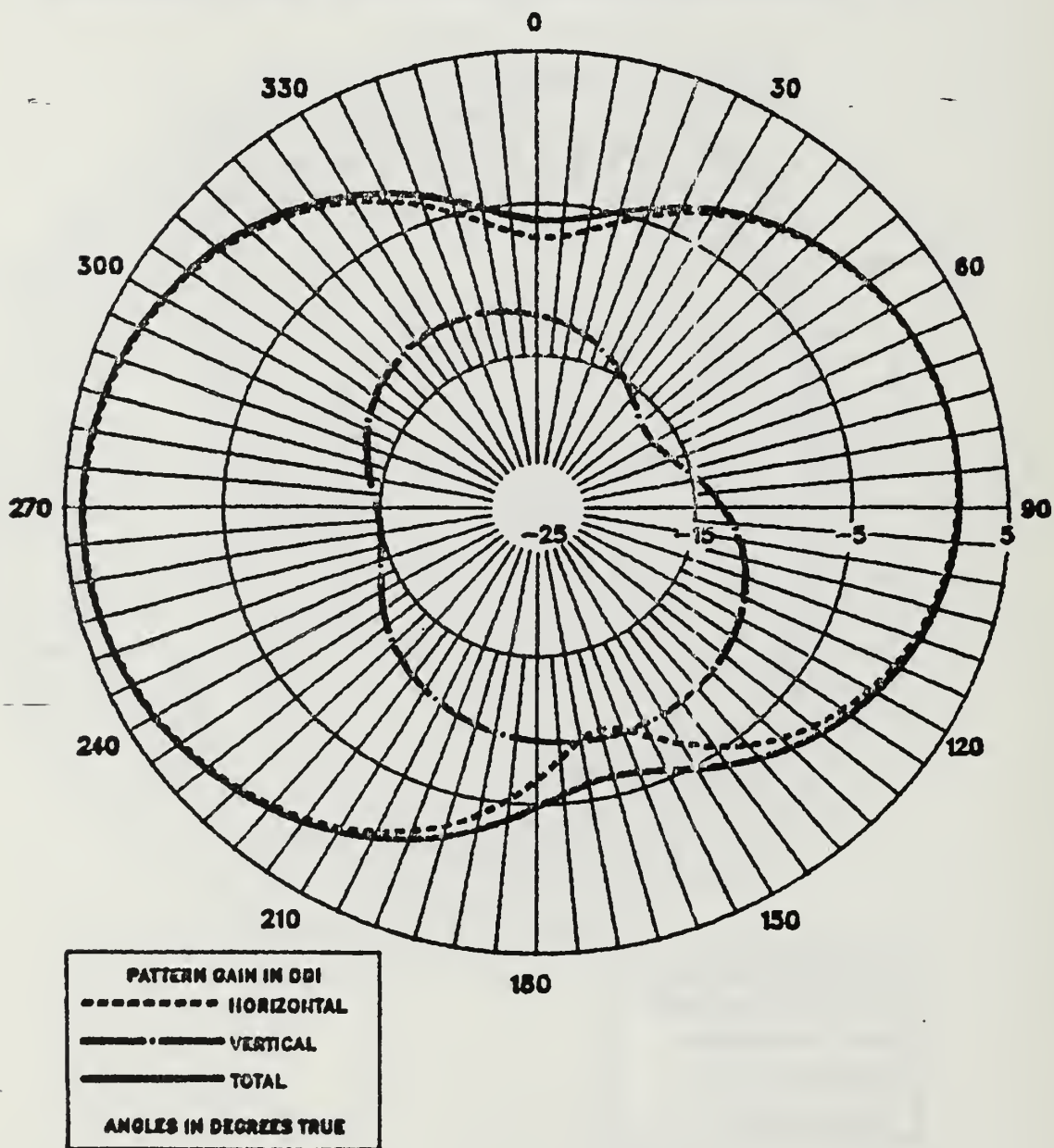
H65 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, $\Phi=45$



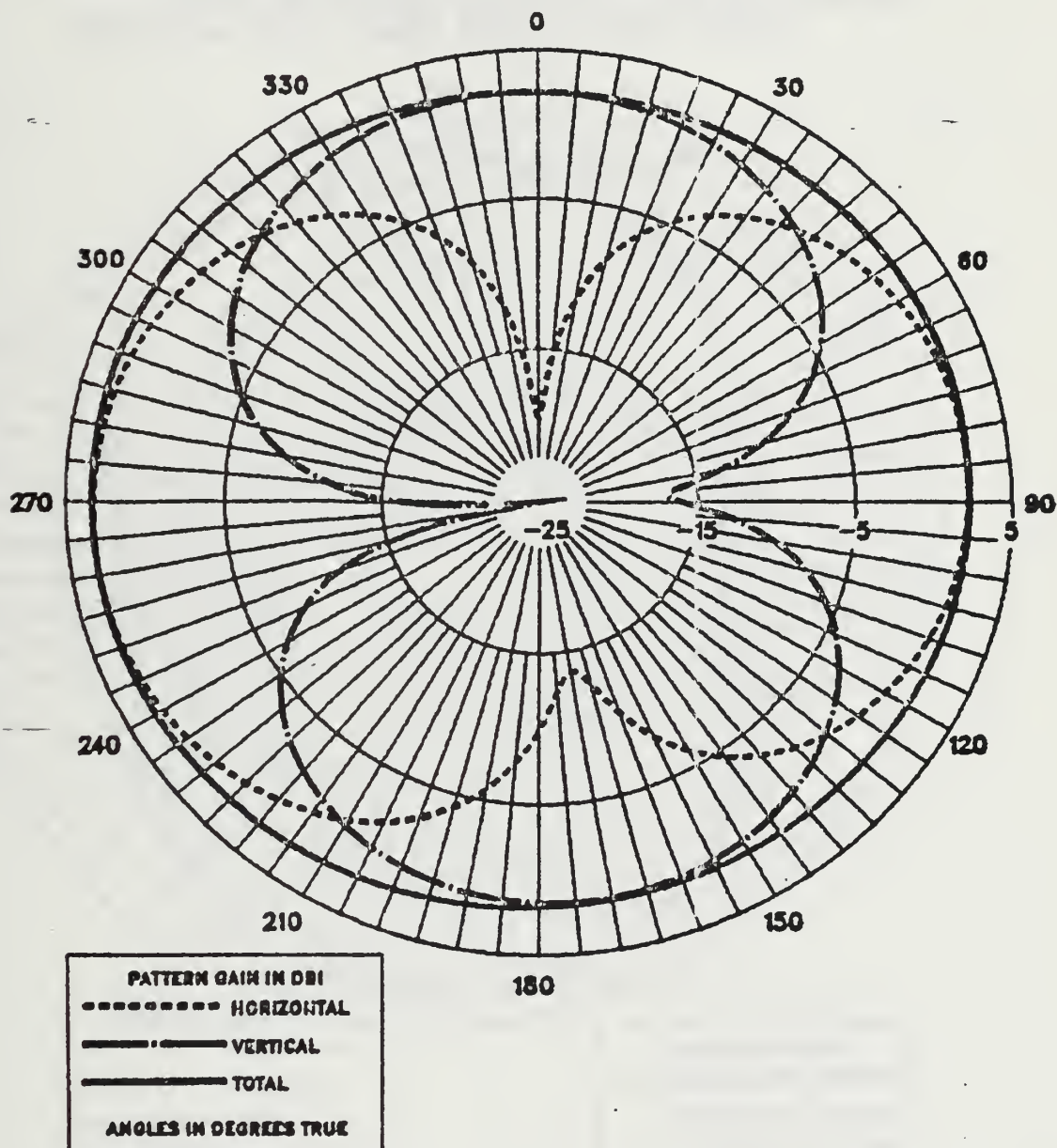
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



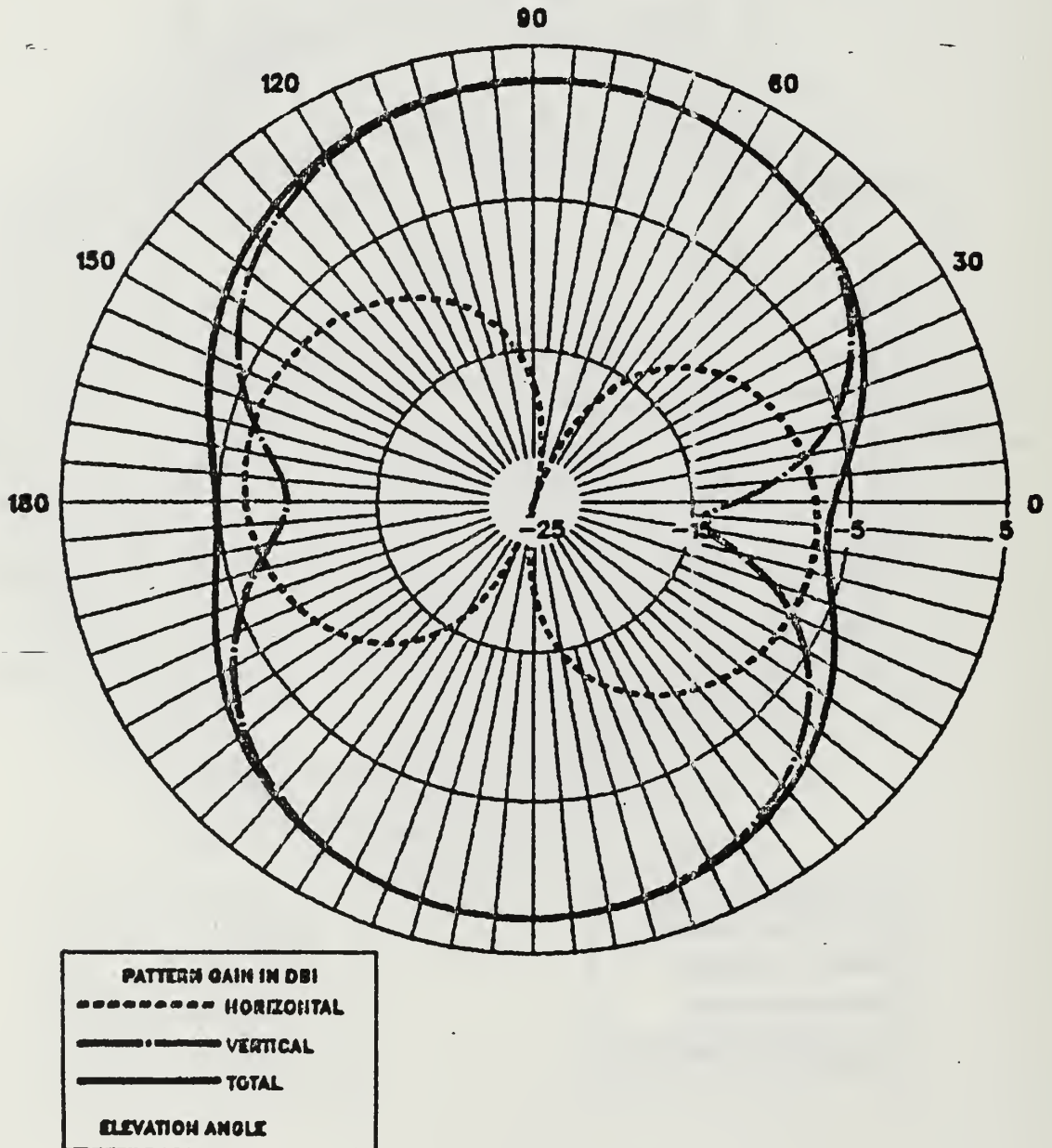
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



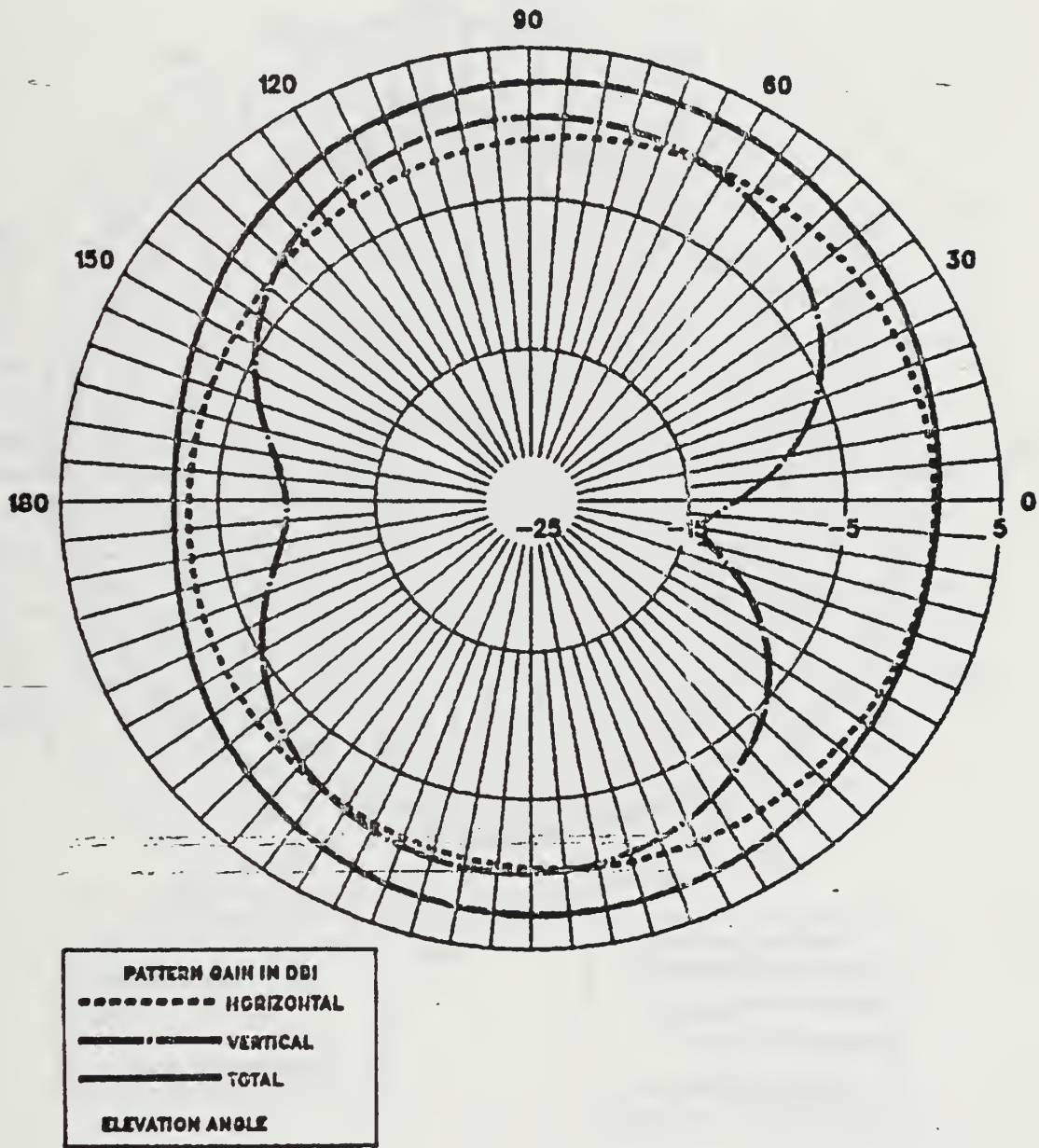
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



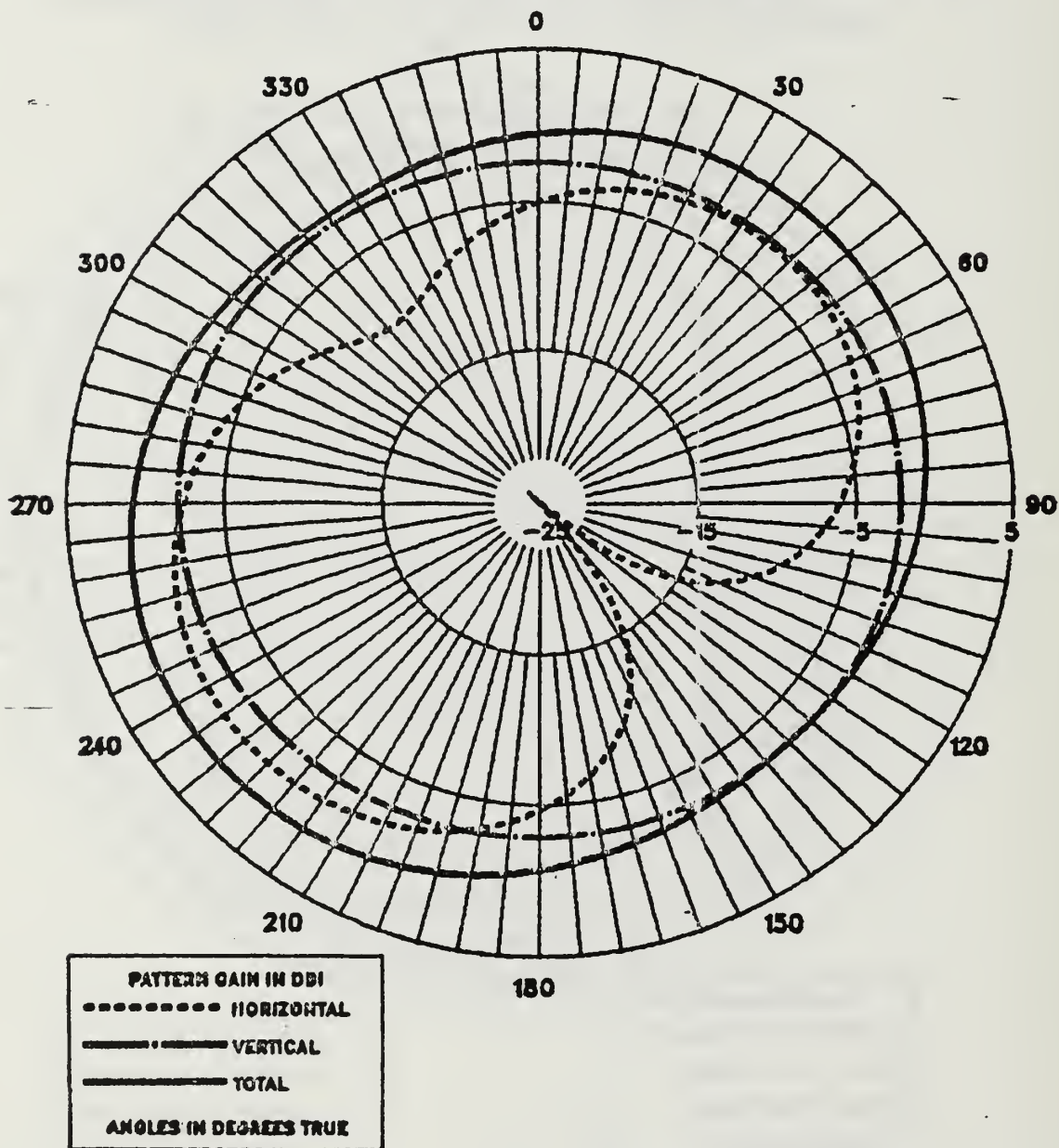
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



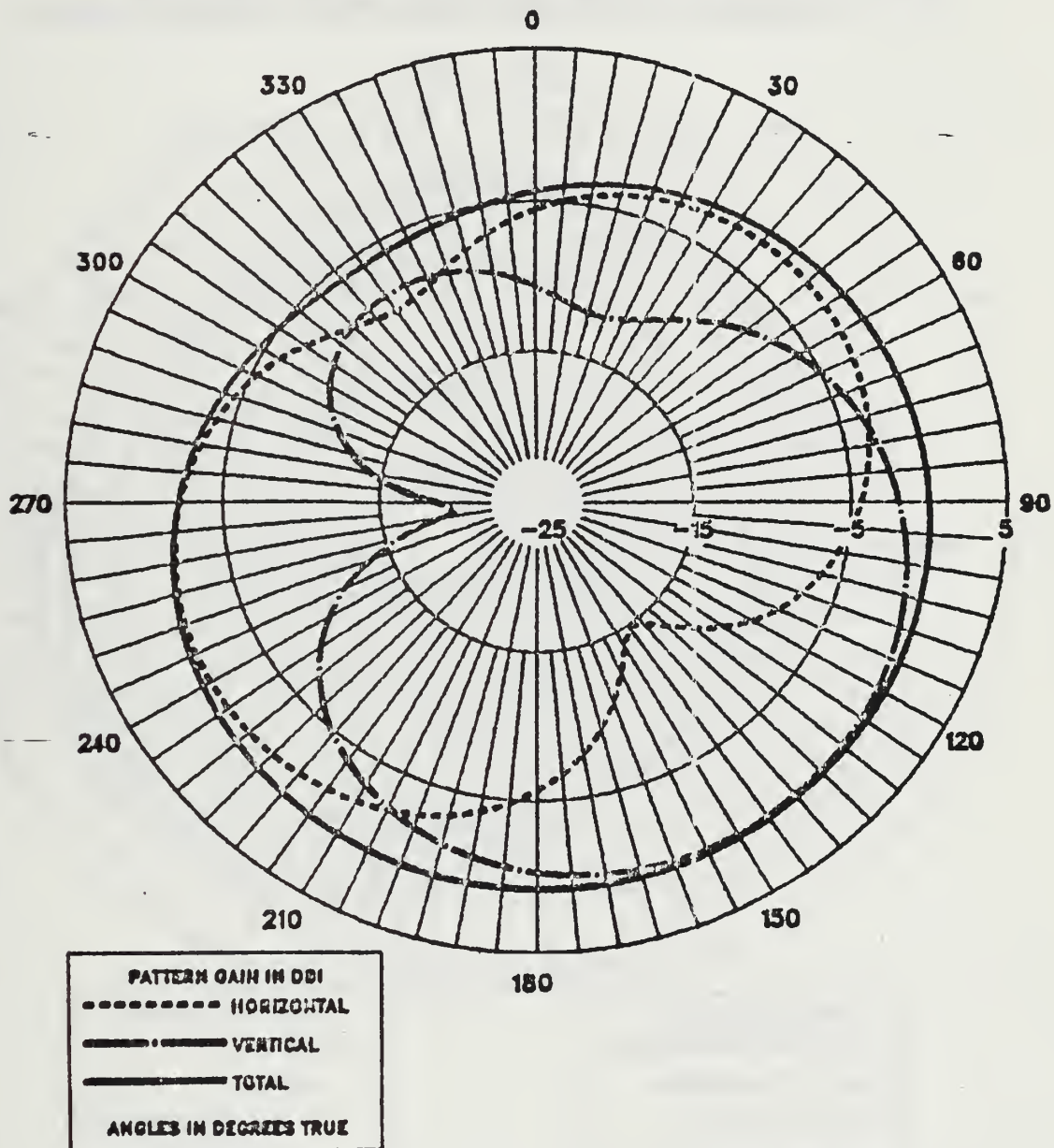
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



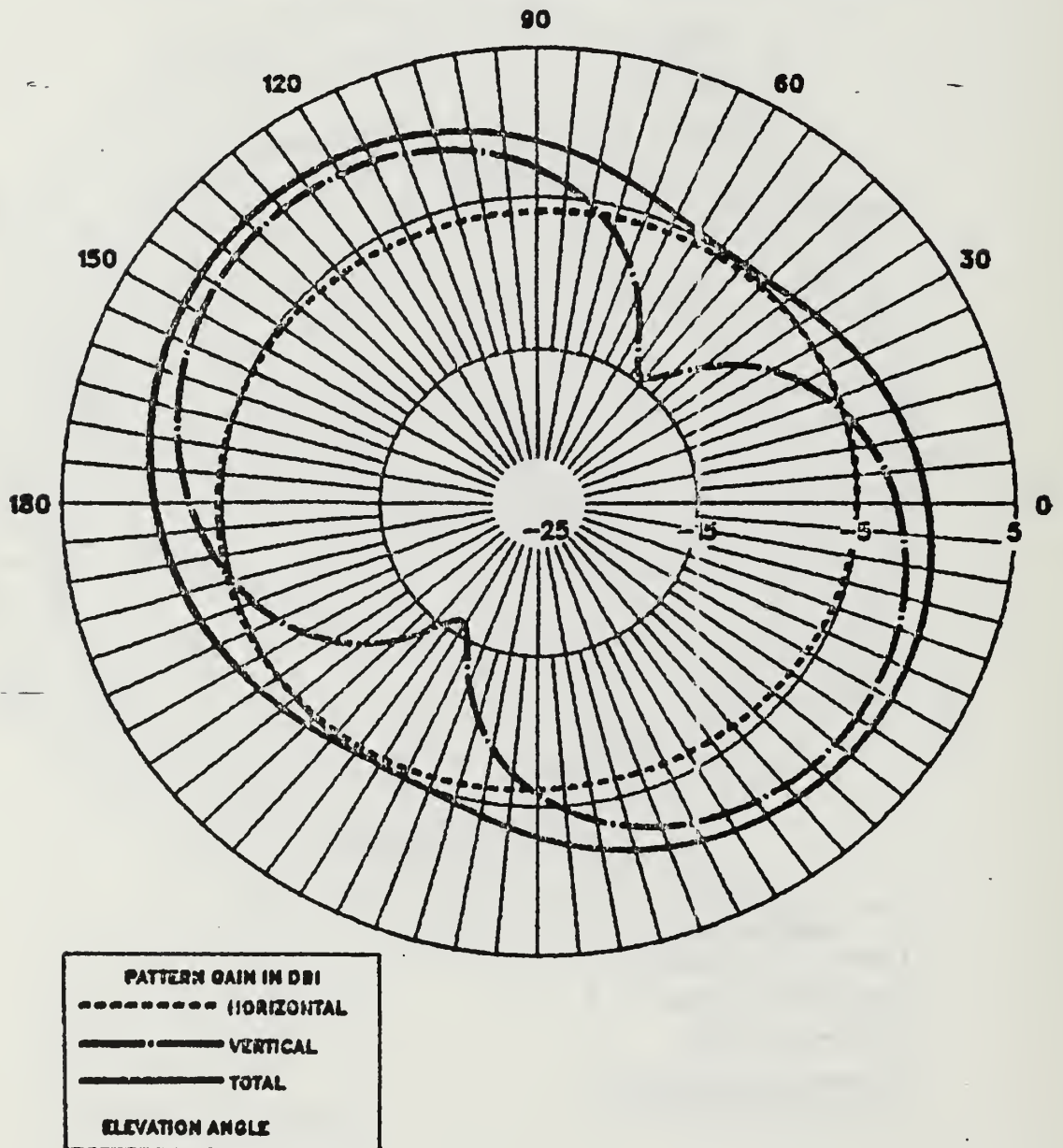
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



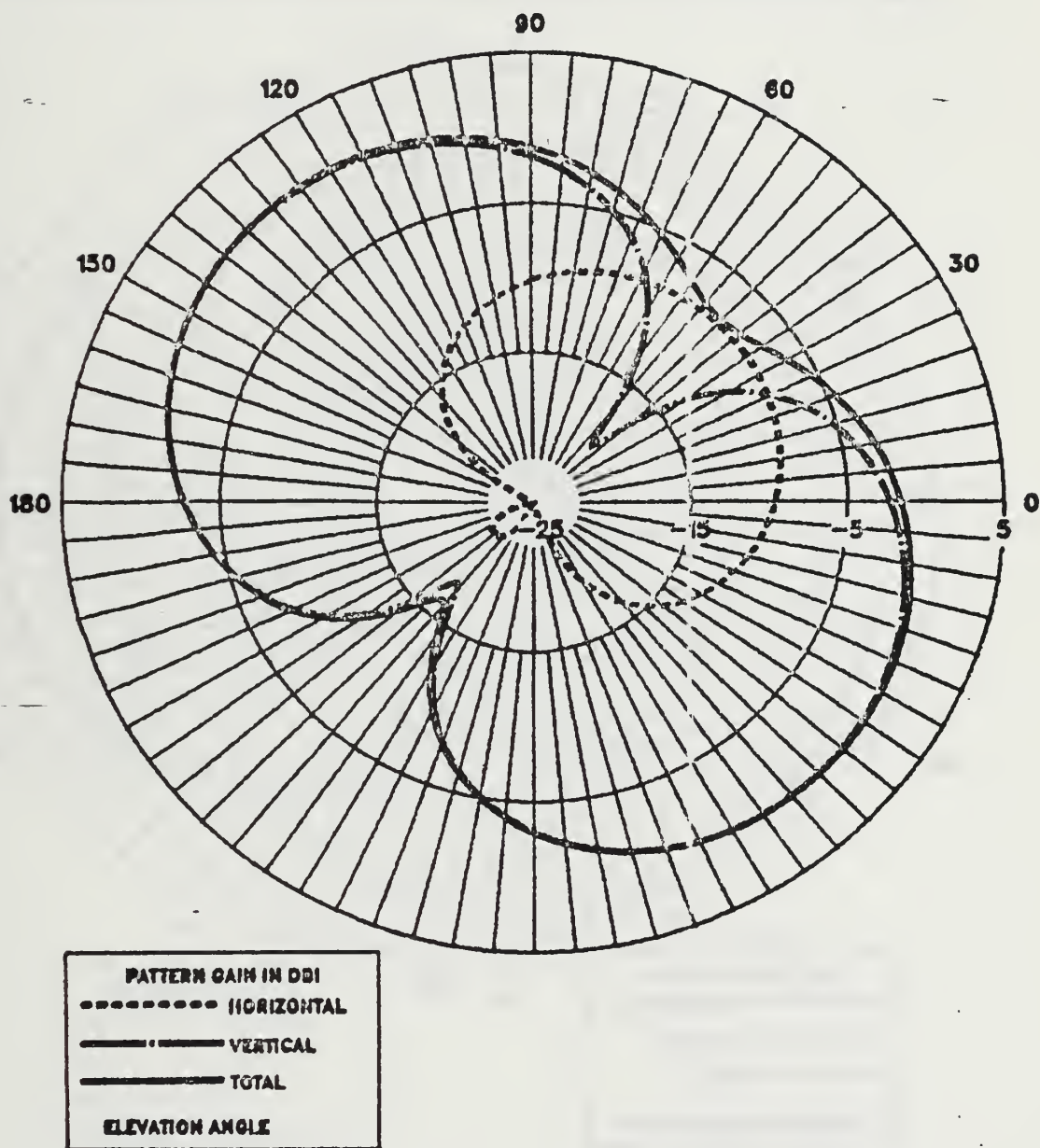
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, $\Phi=0$



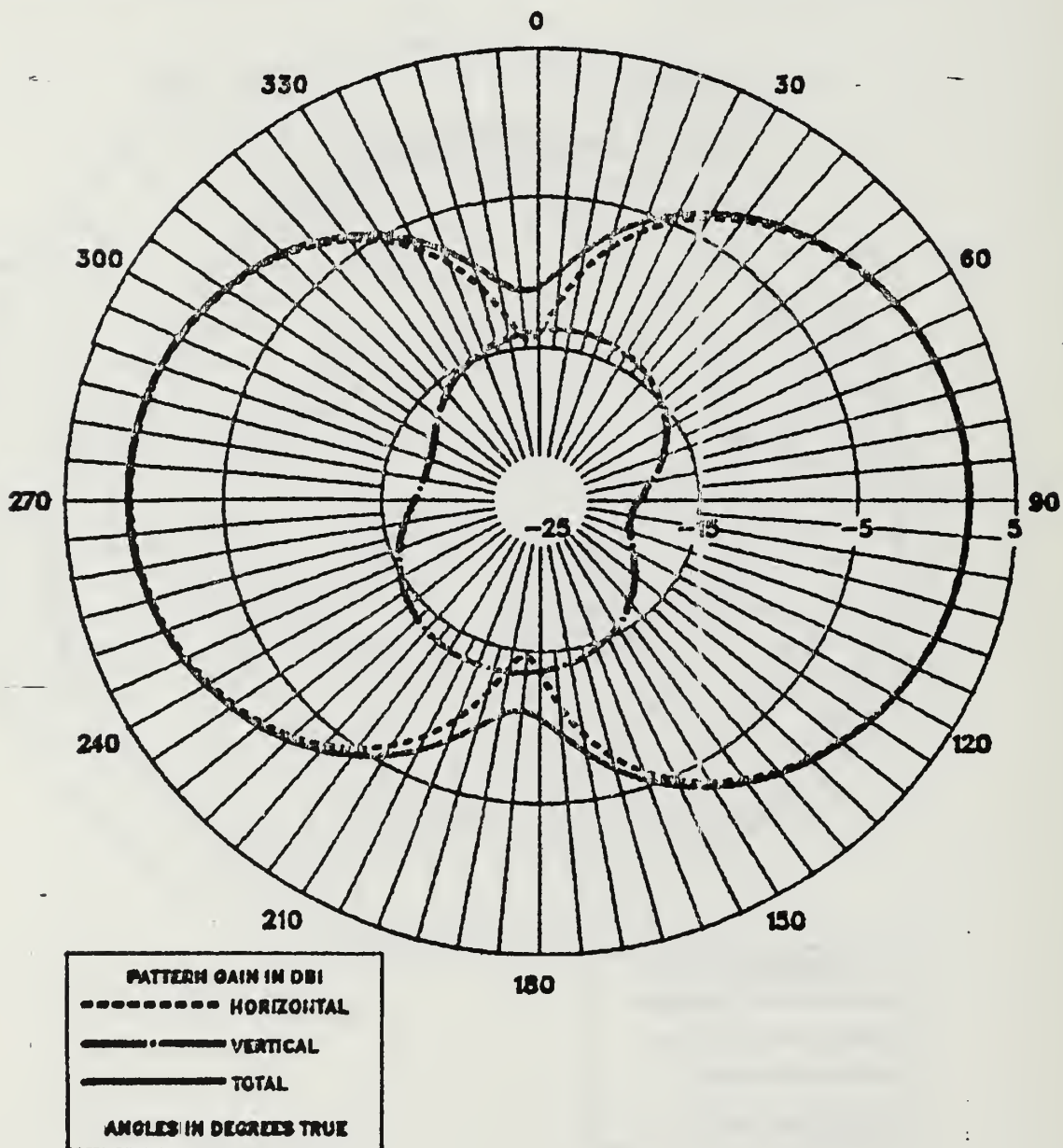
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



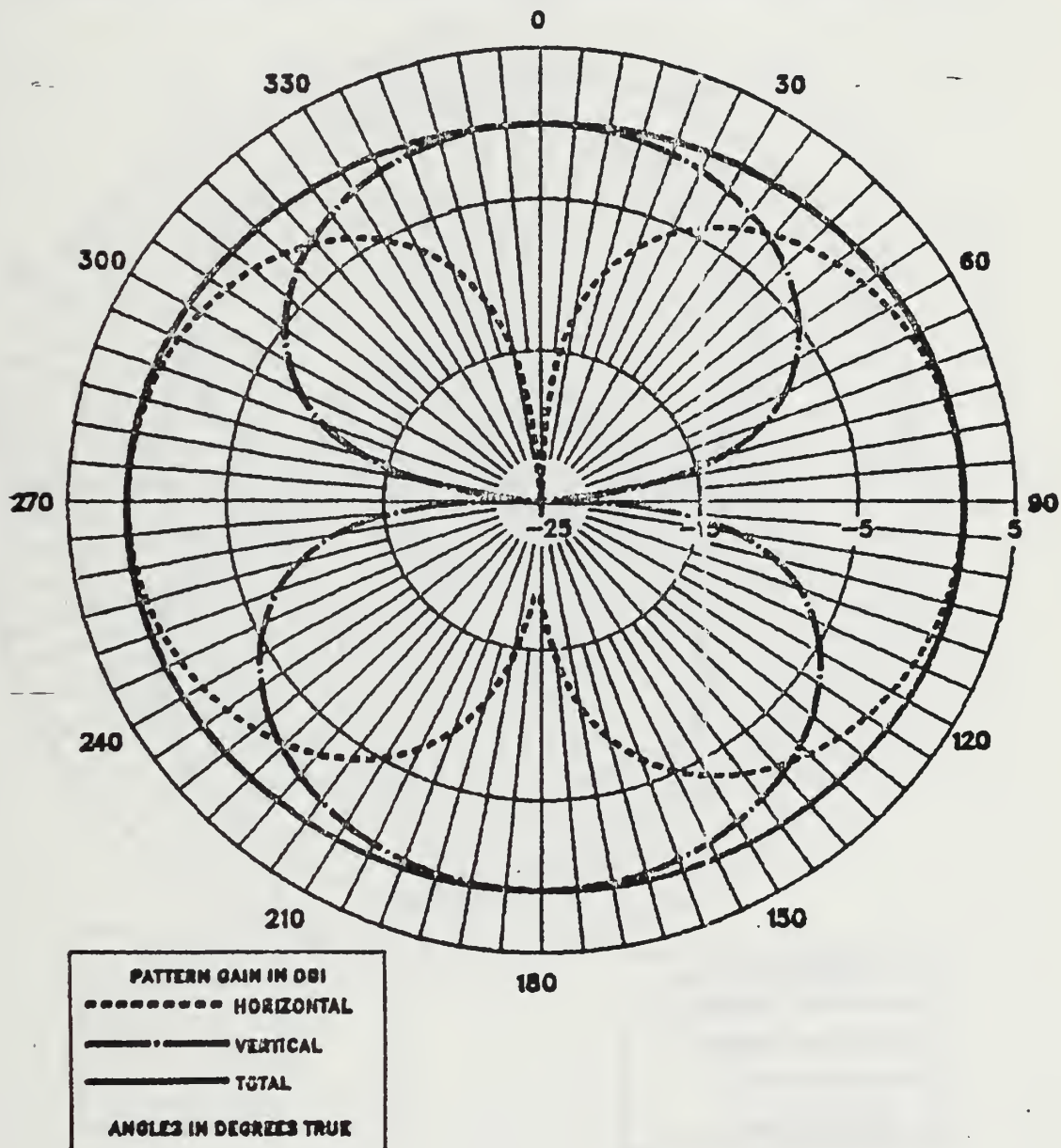
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



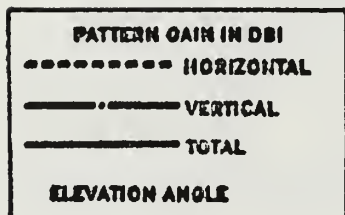
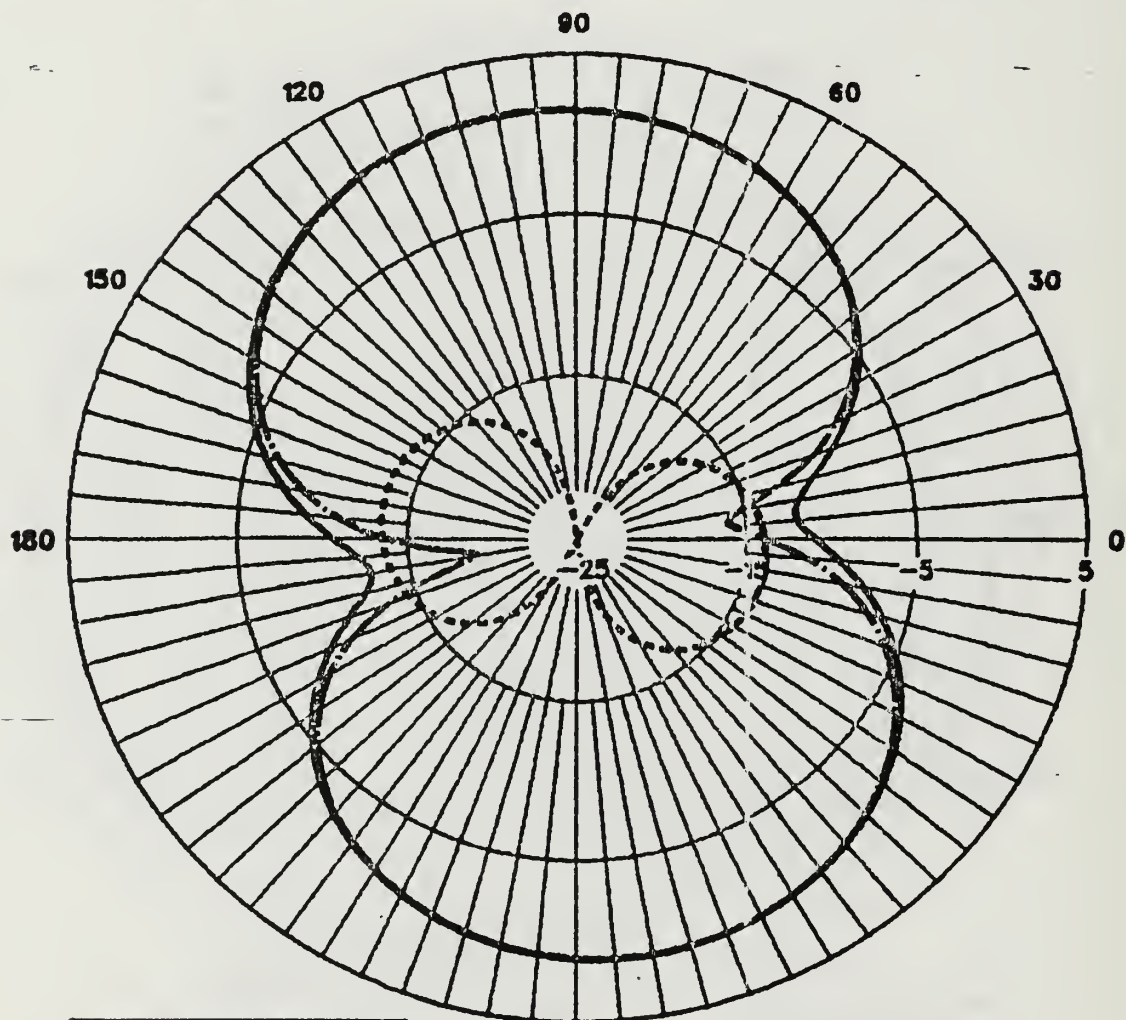
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



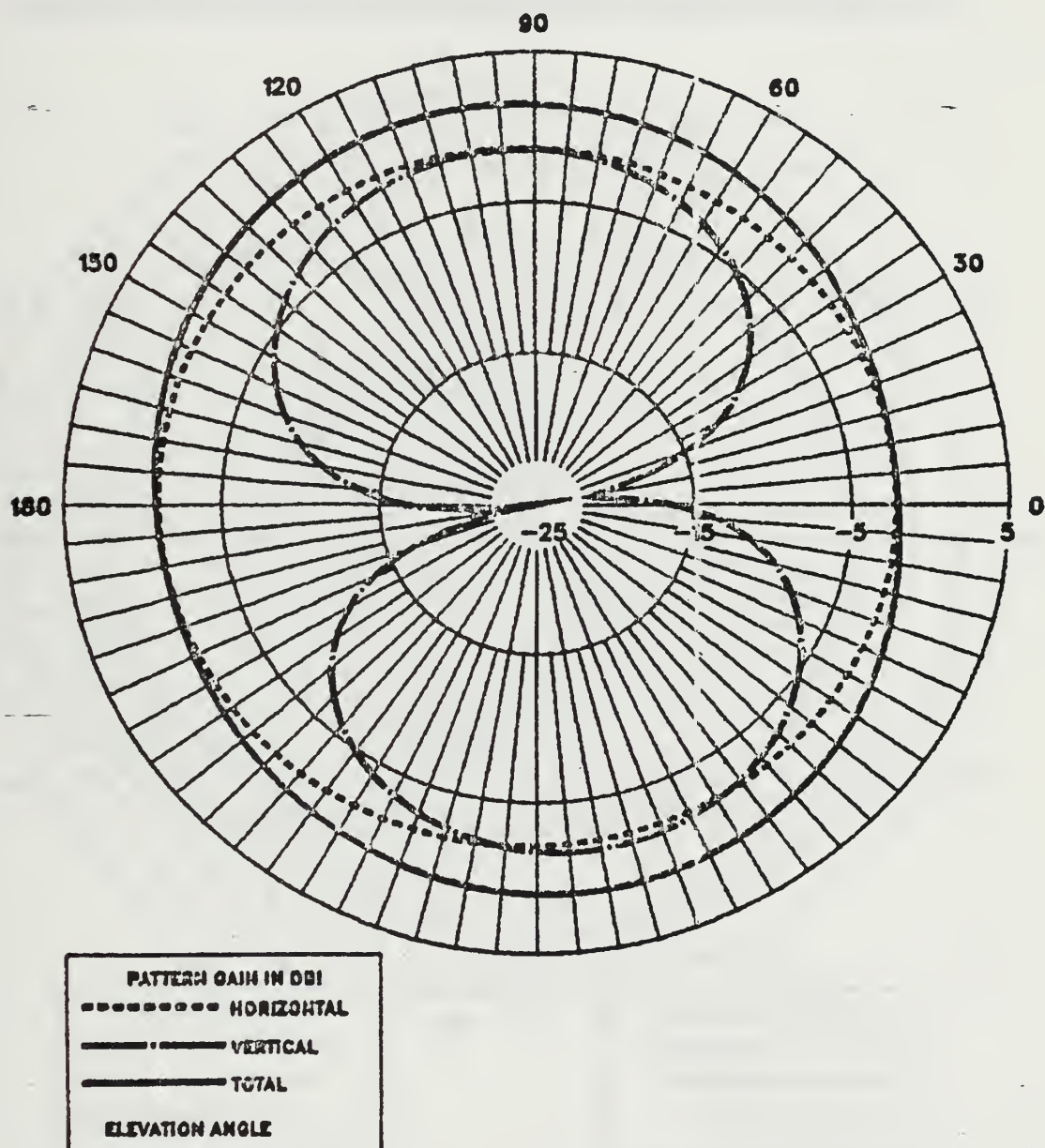
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



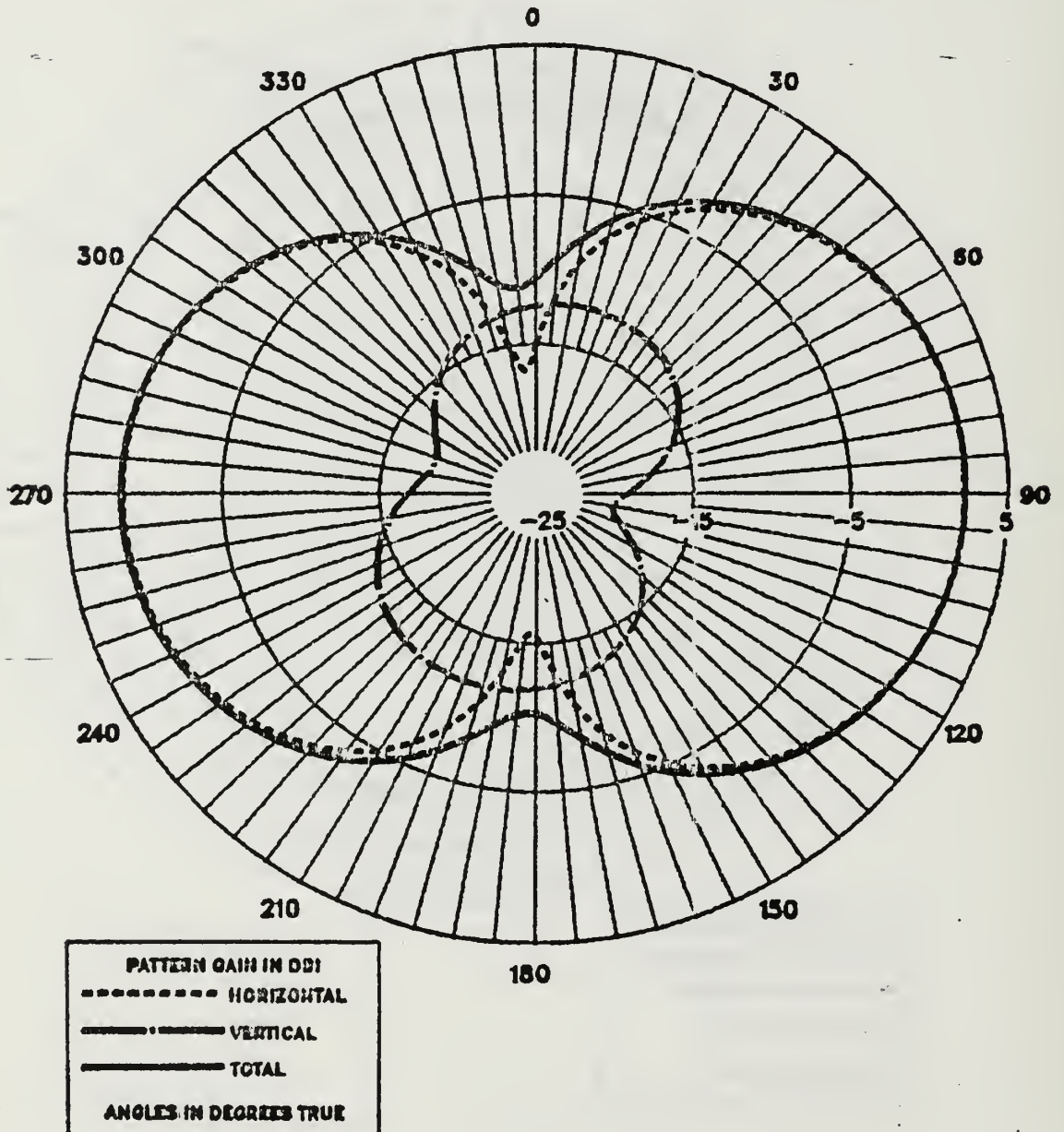
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



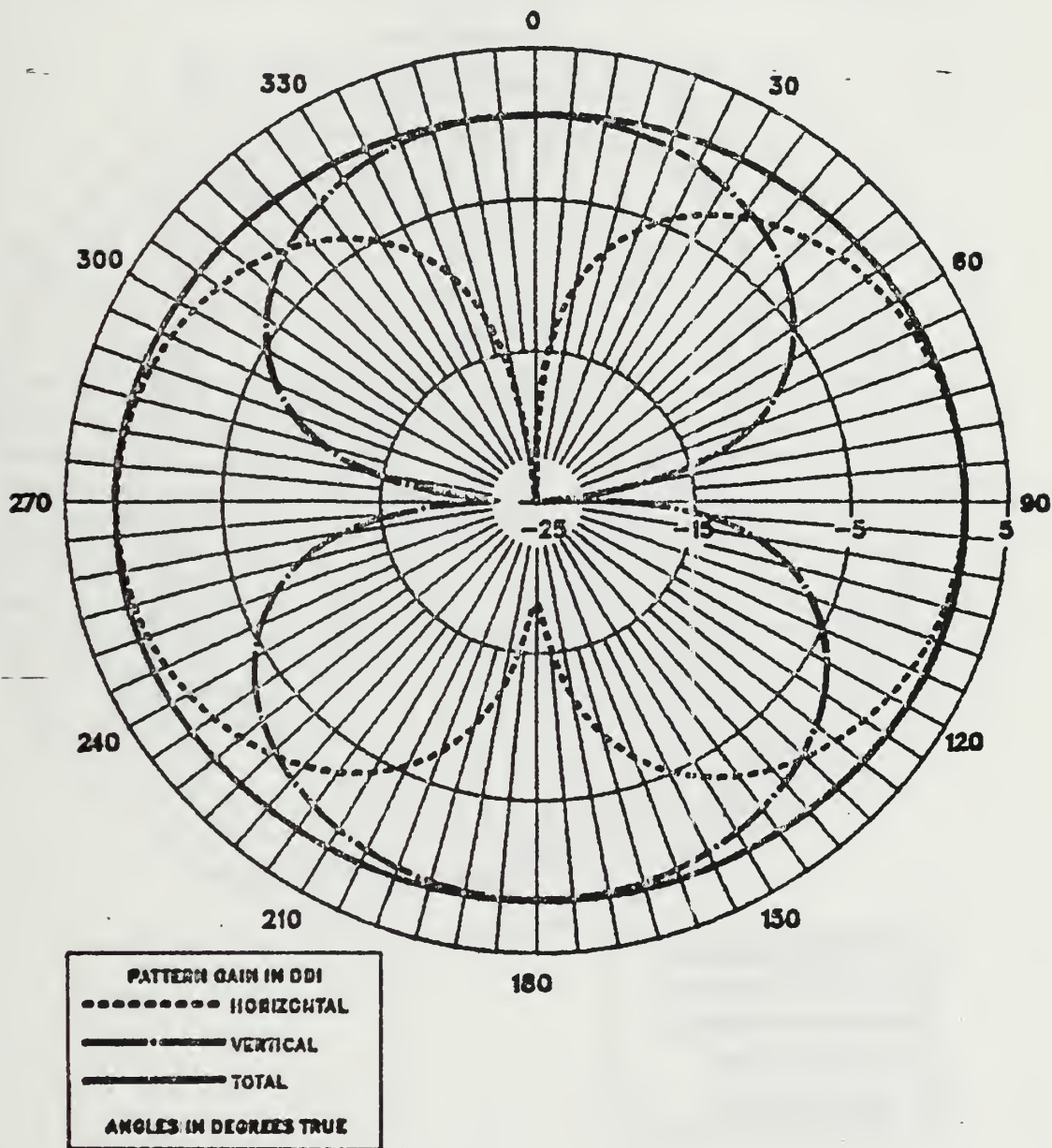
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LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



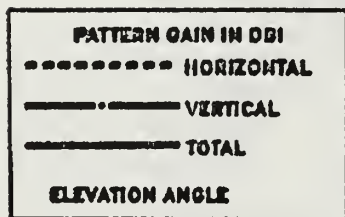
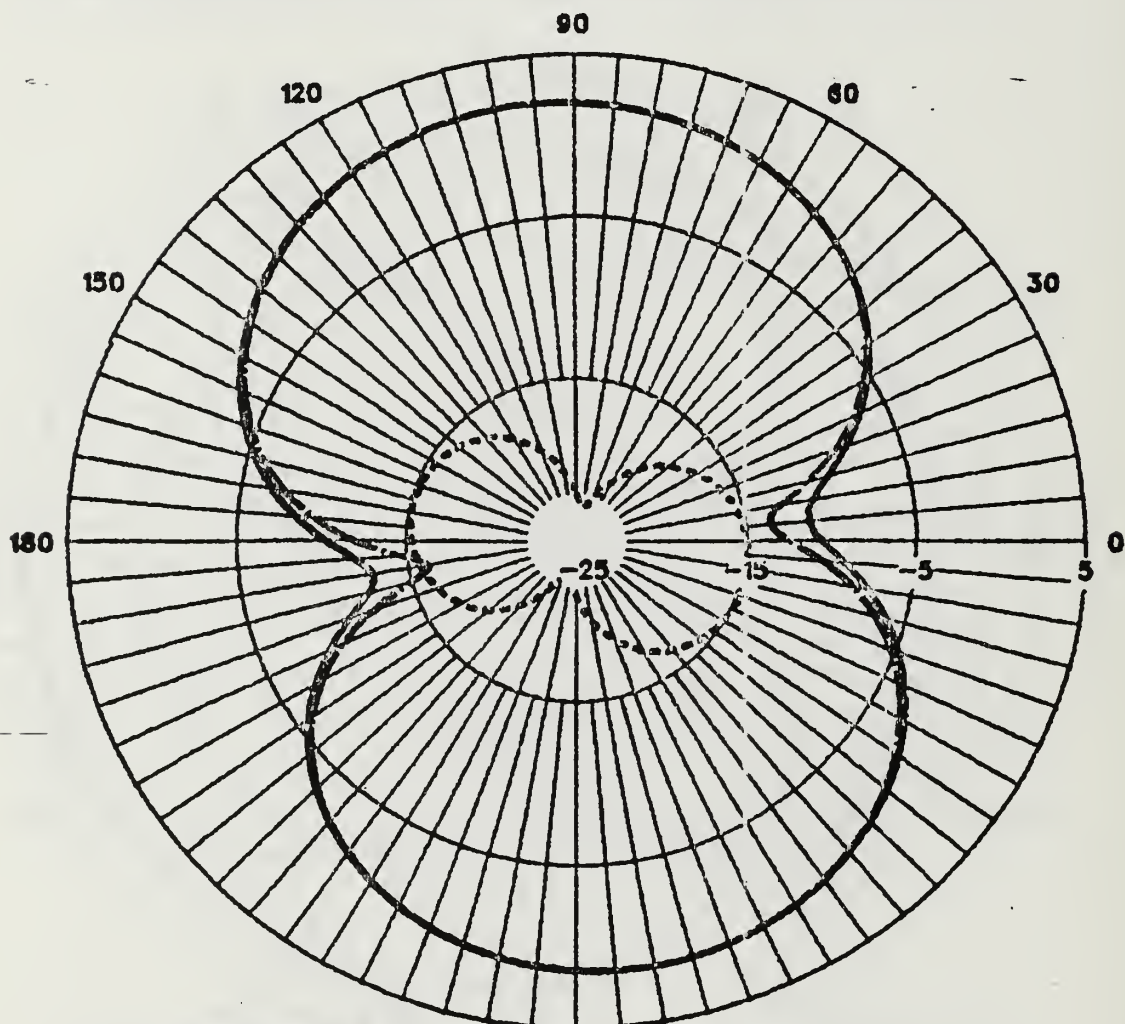
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, $\theta=26$



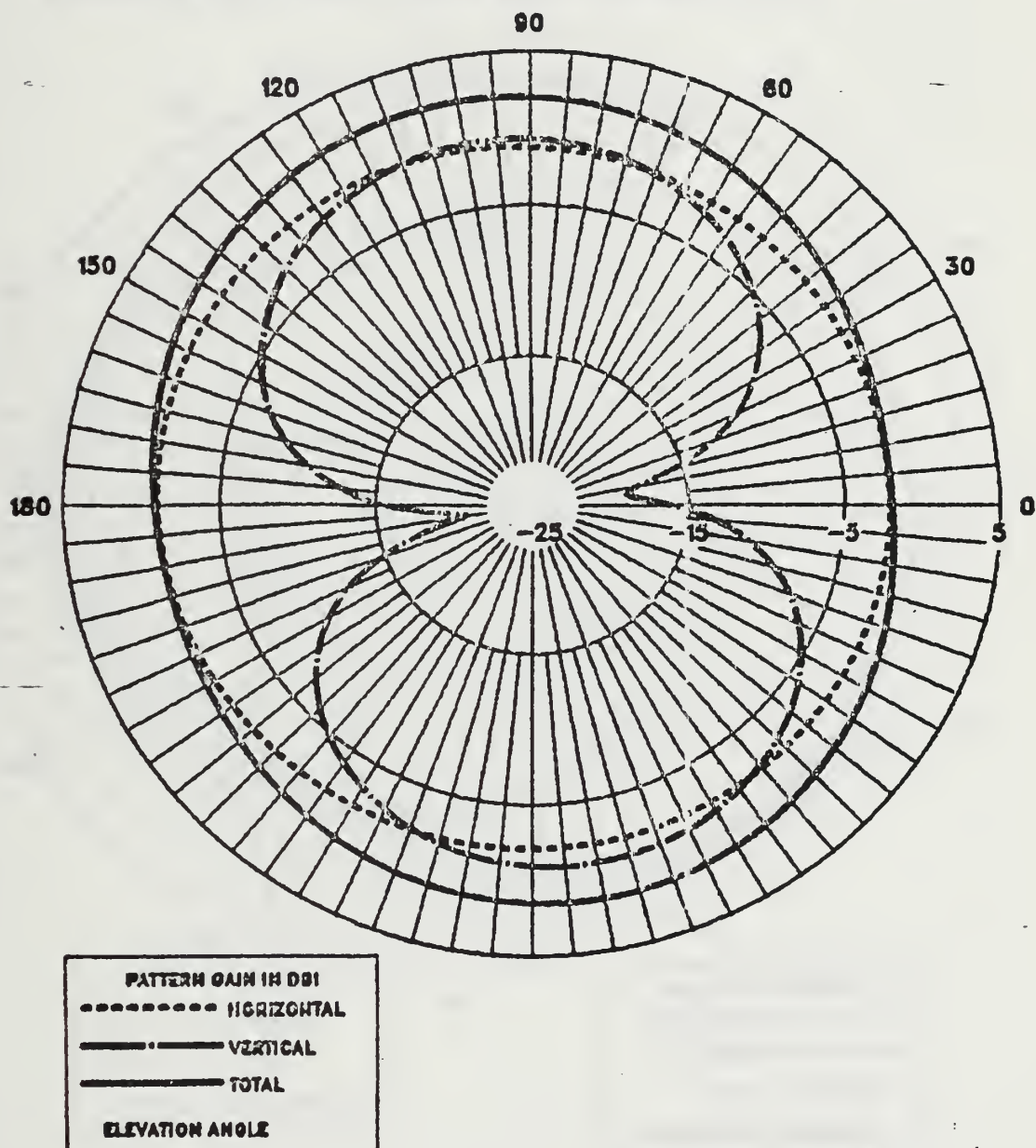
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=0



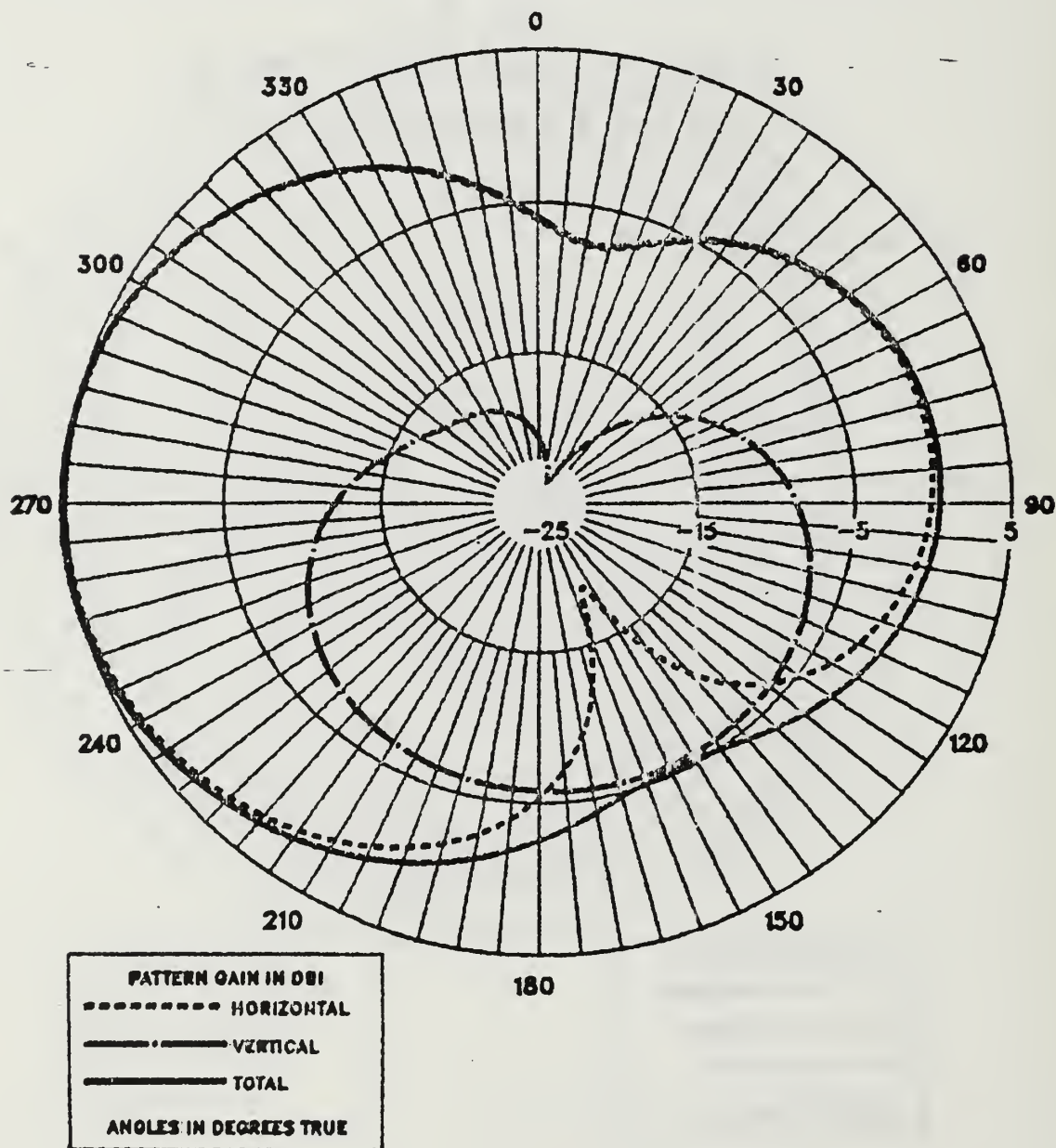
H65 IGUANA DATA RUN AT 7.645MHZ ON 8/22/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, $\Phi=45$



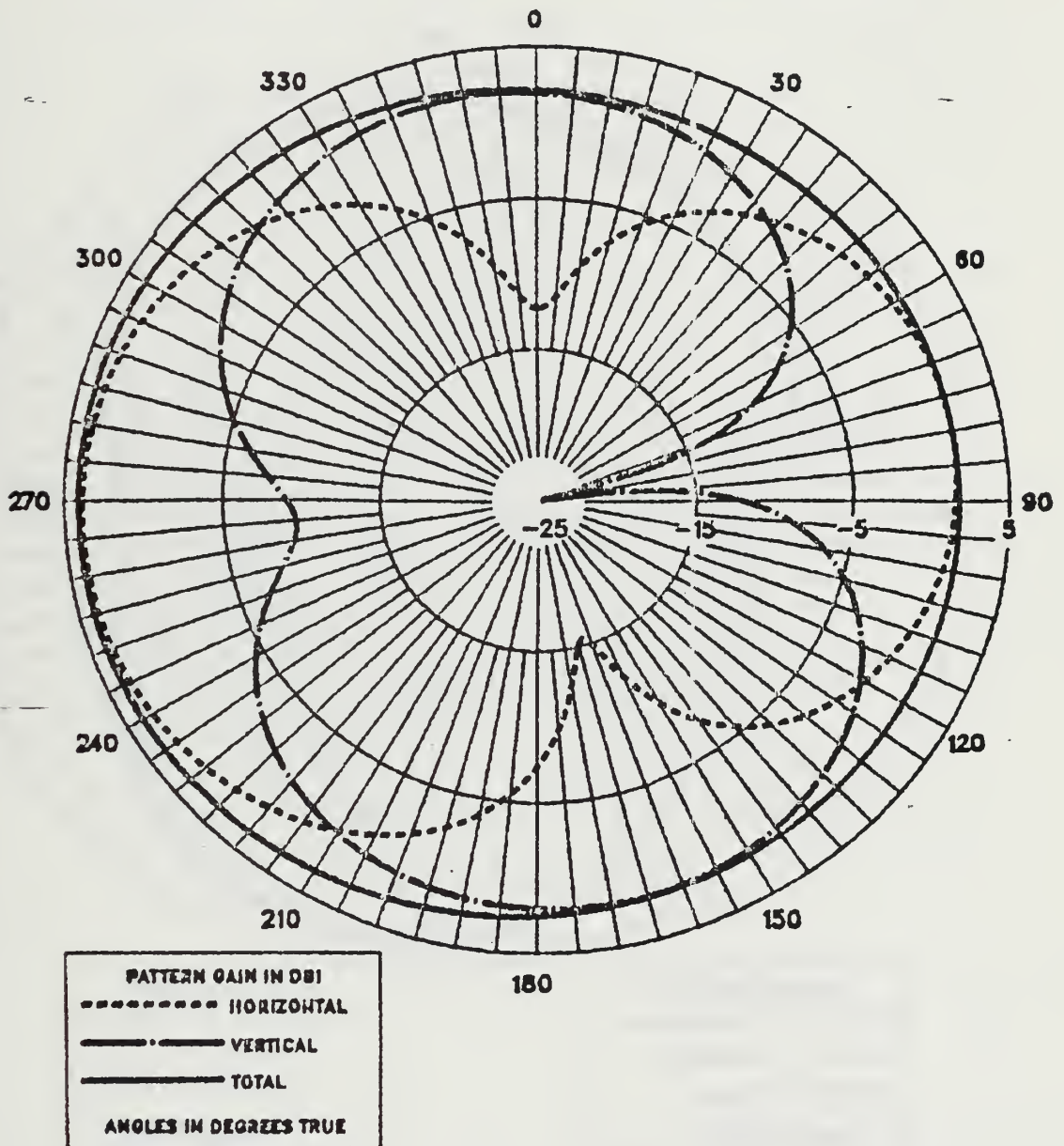
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



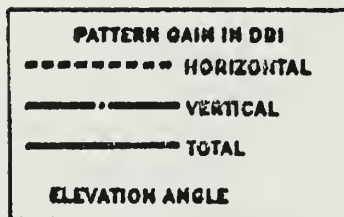
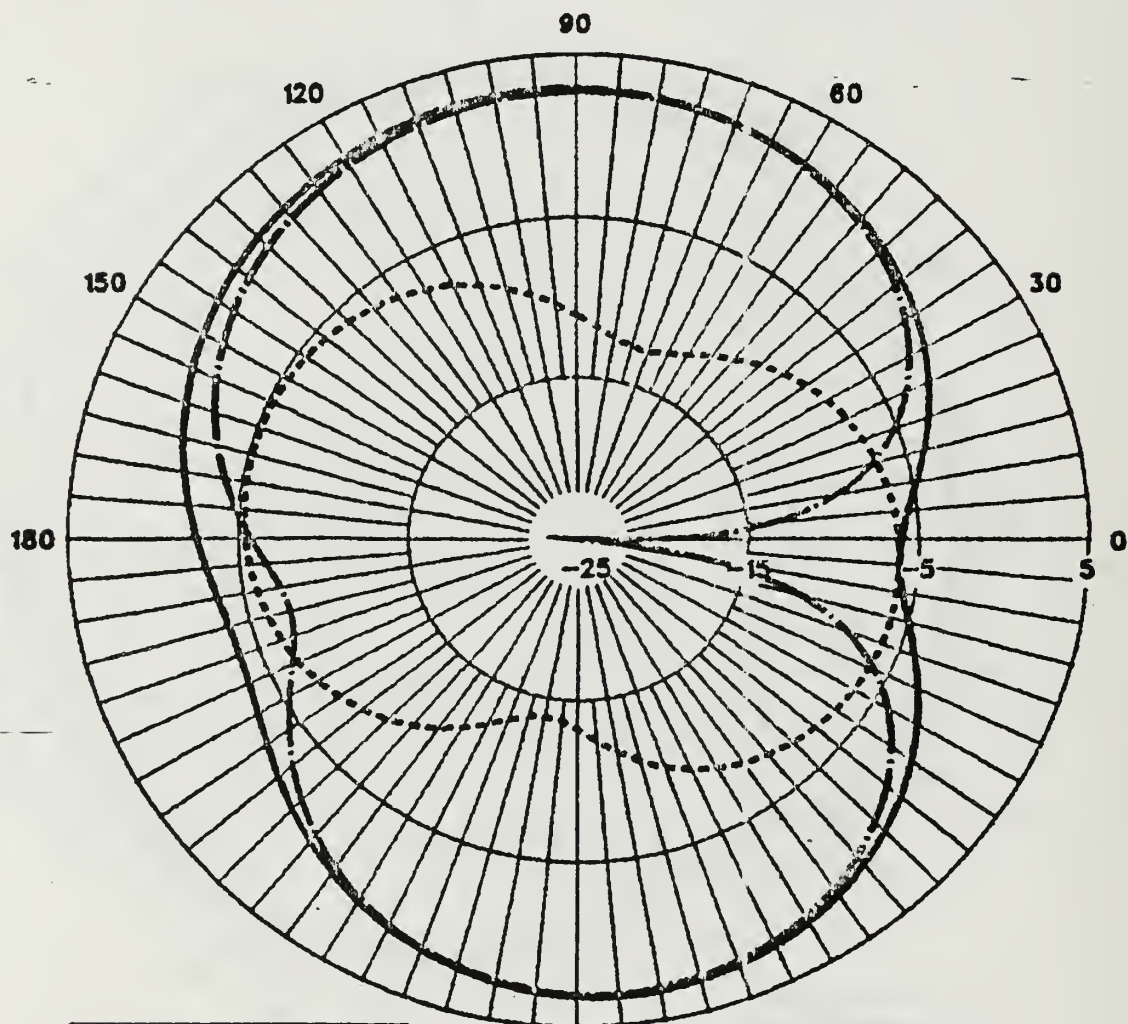
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



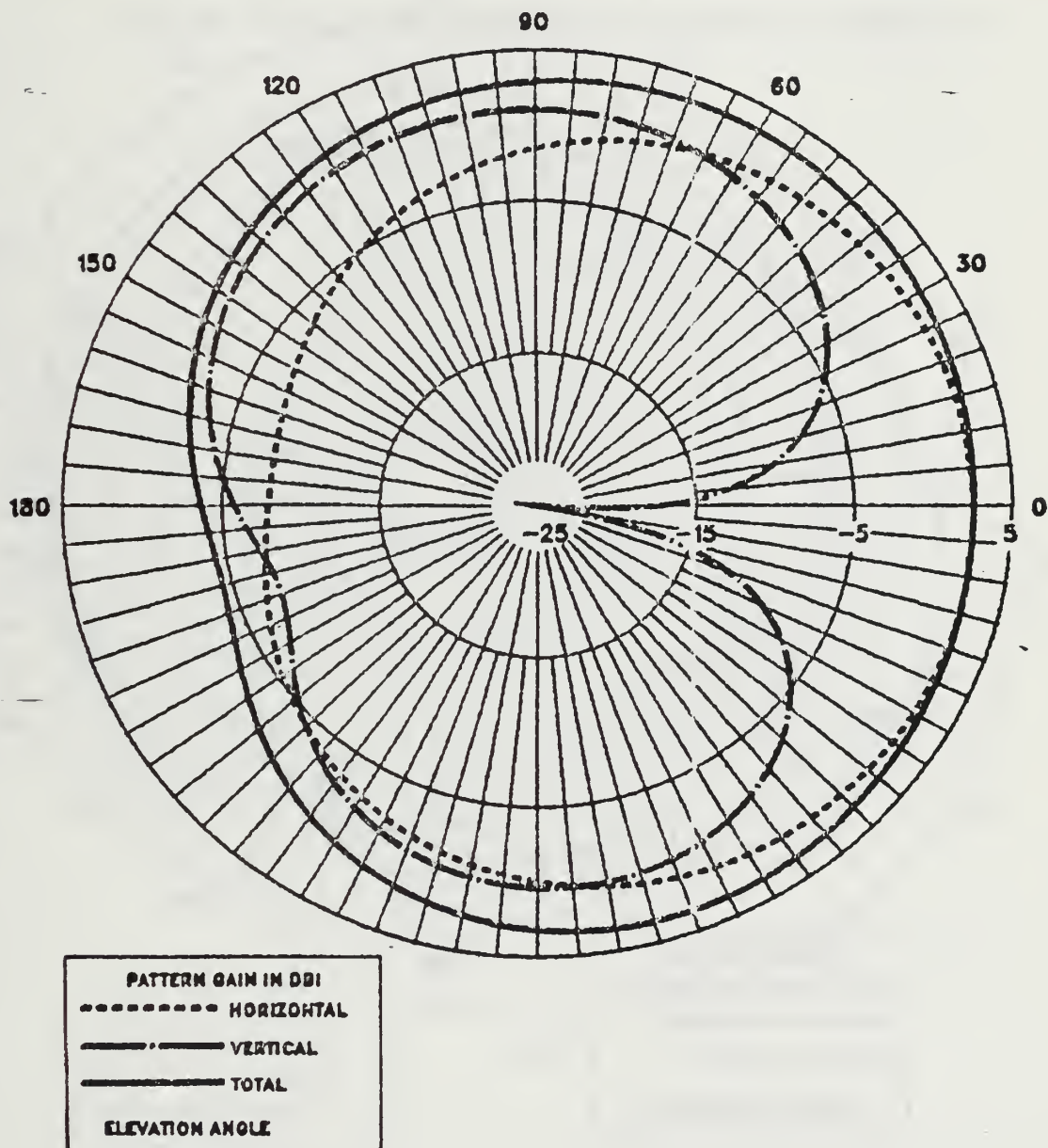
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



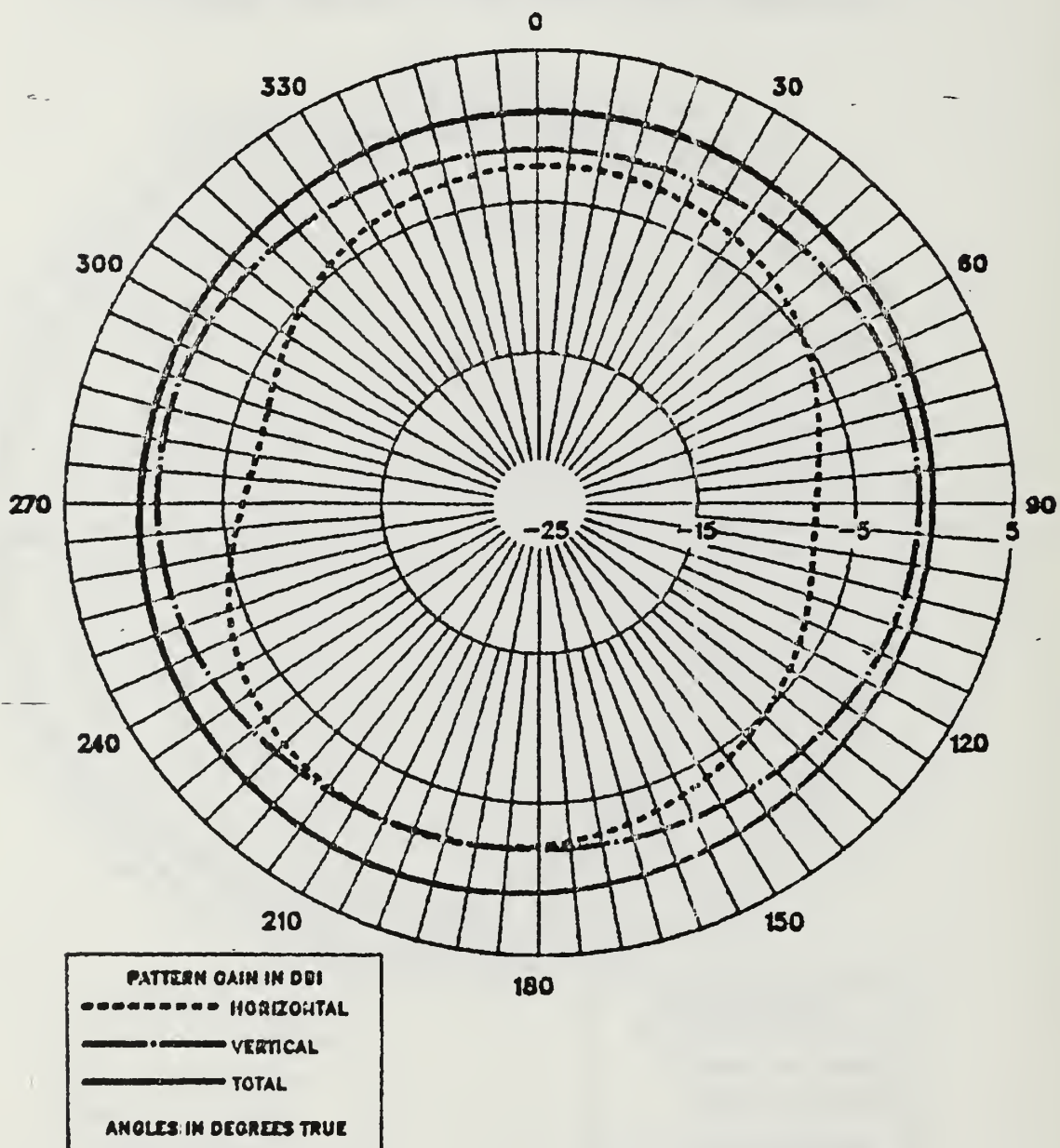
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



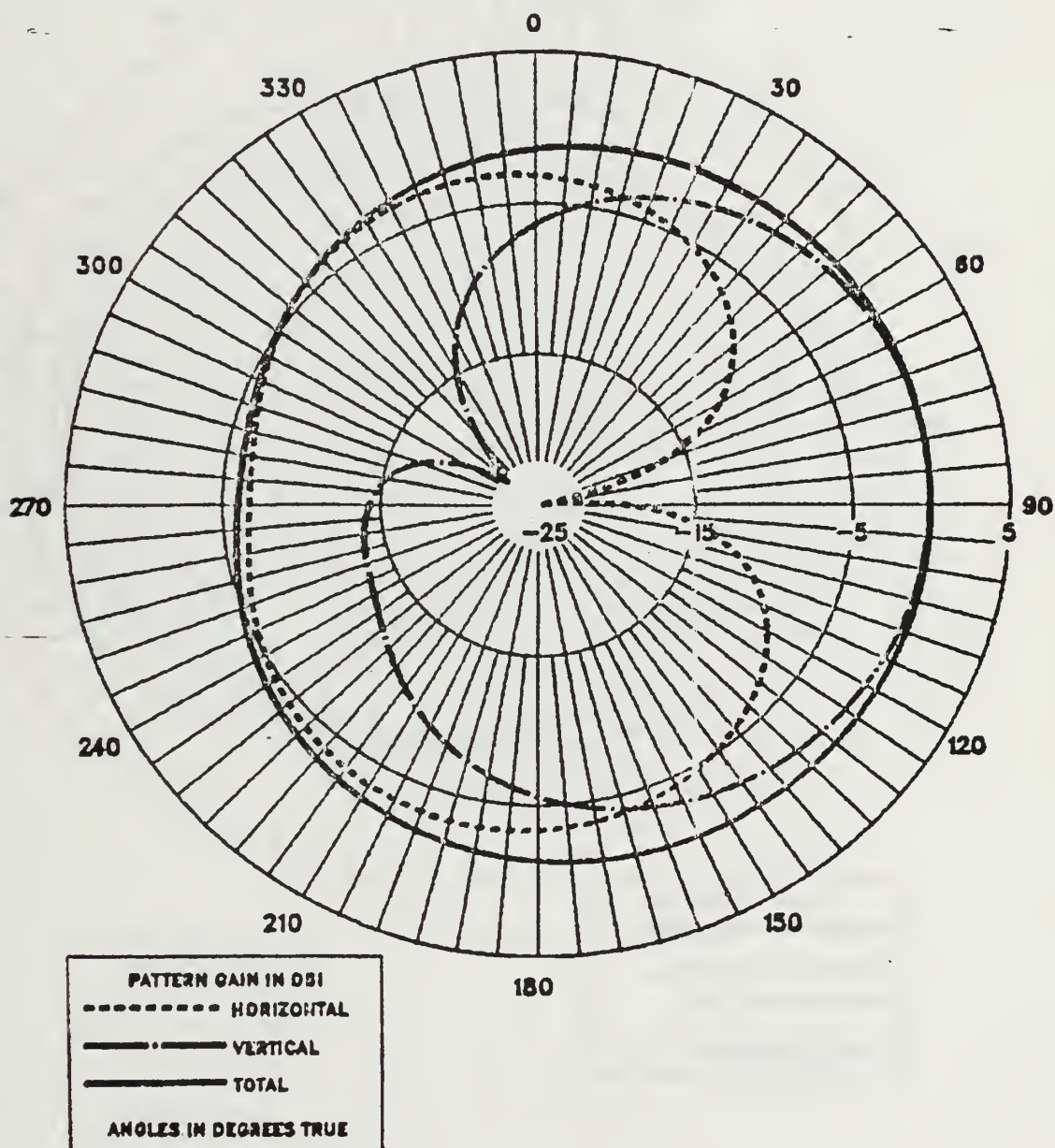
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



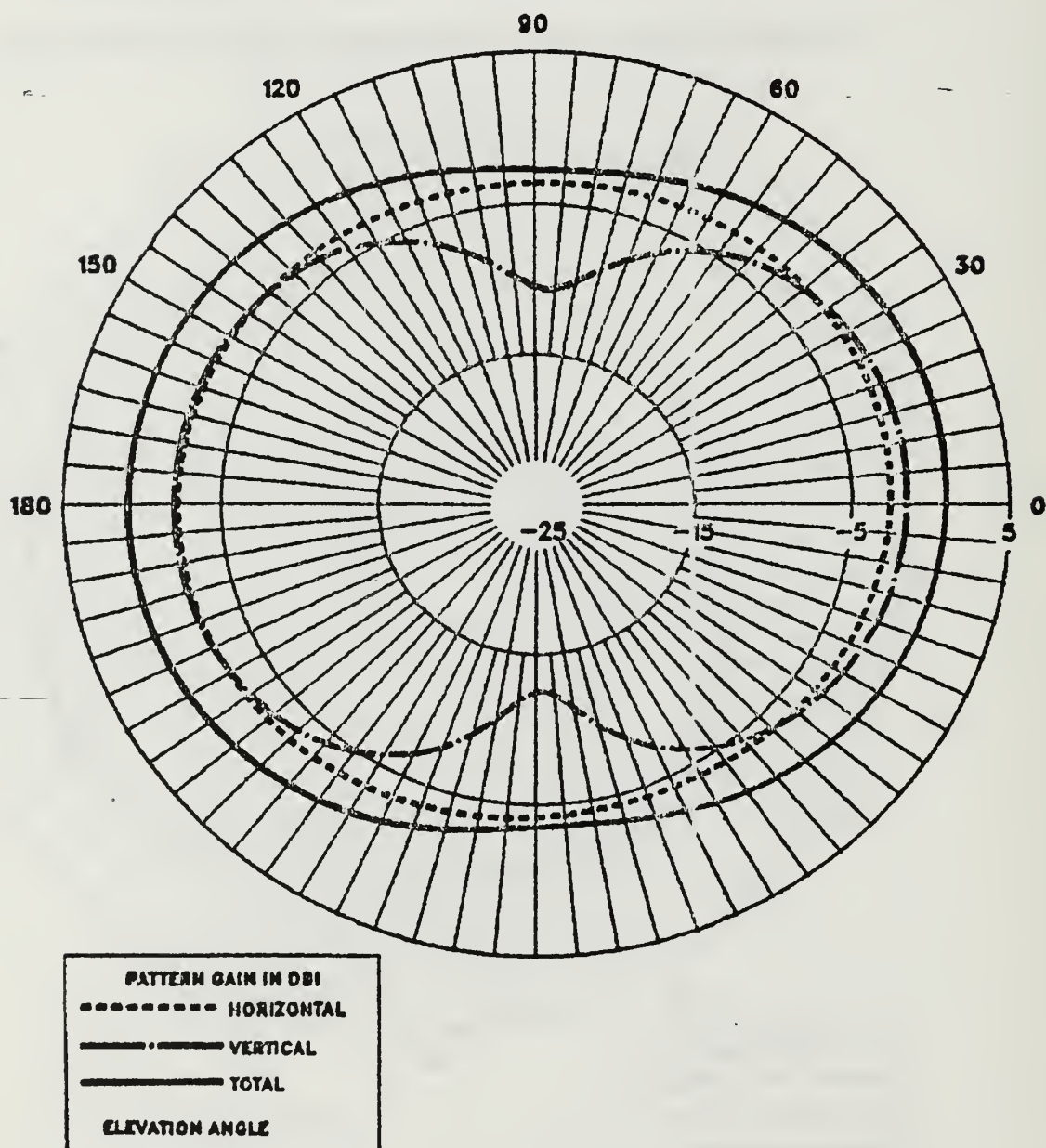
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COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



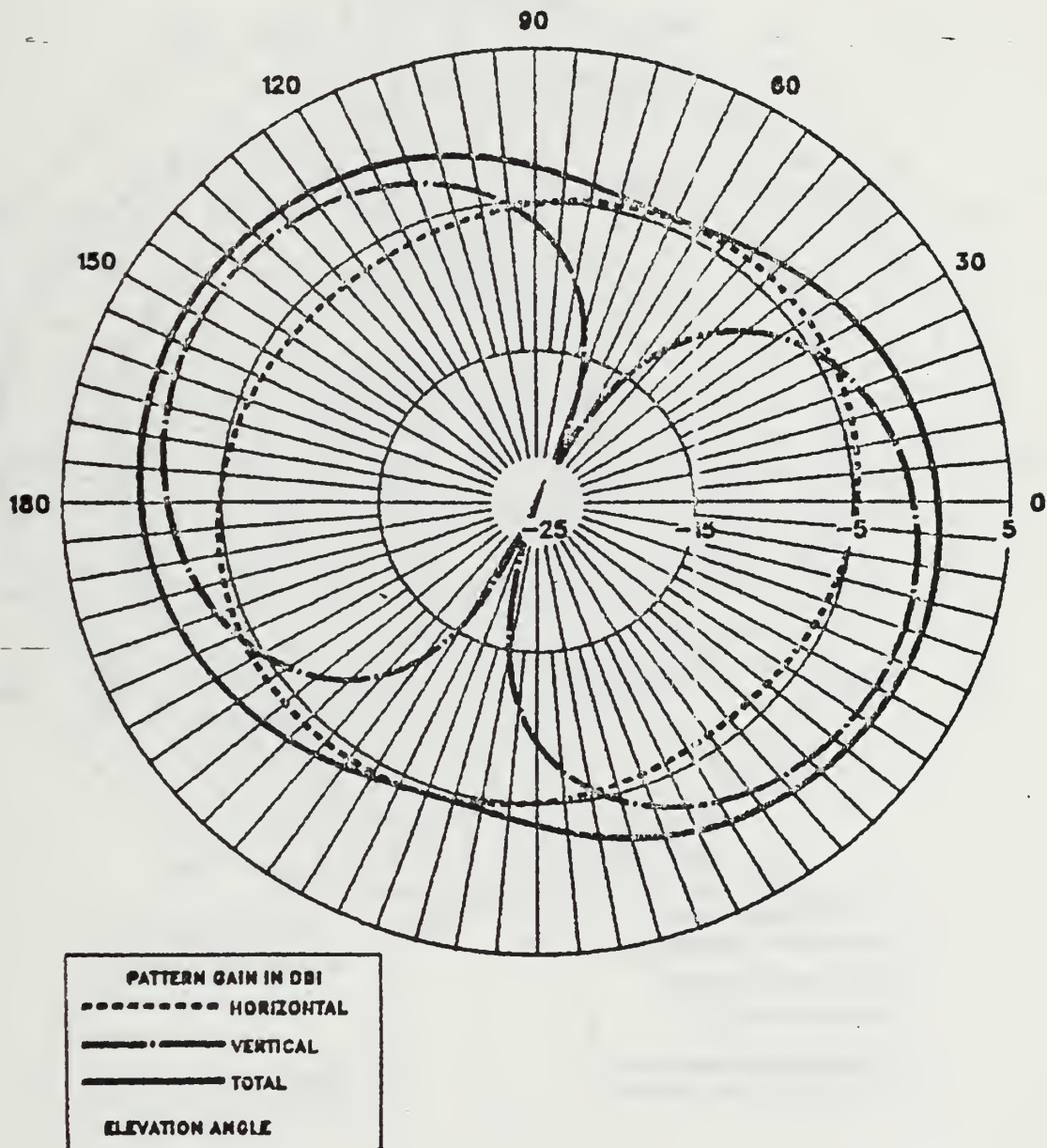
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COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



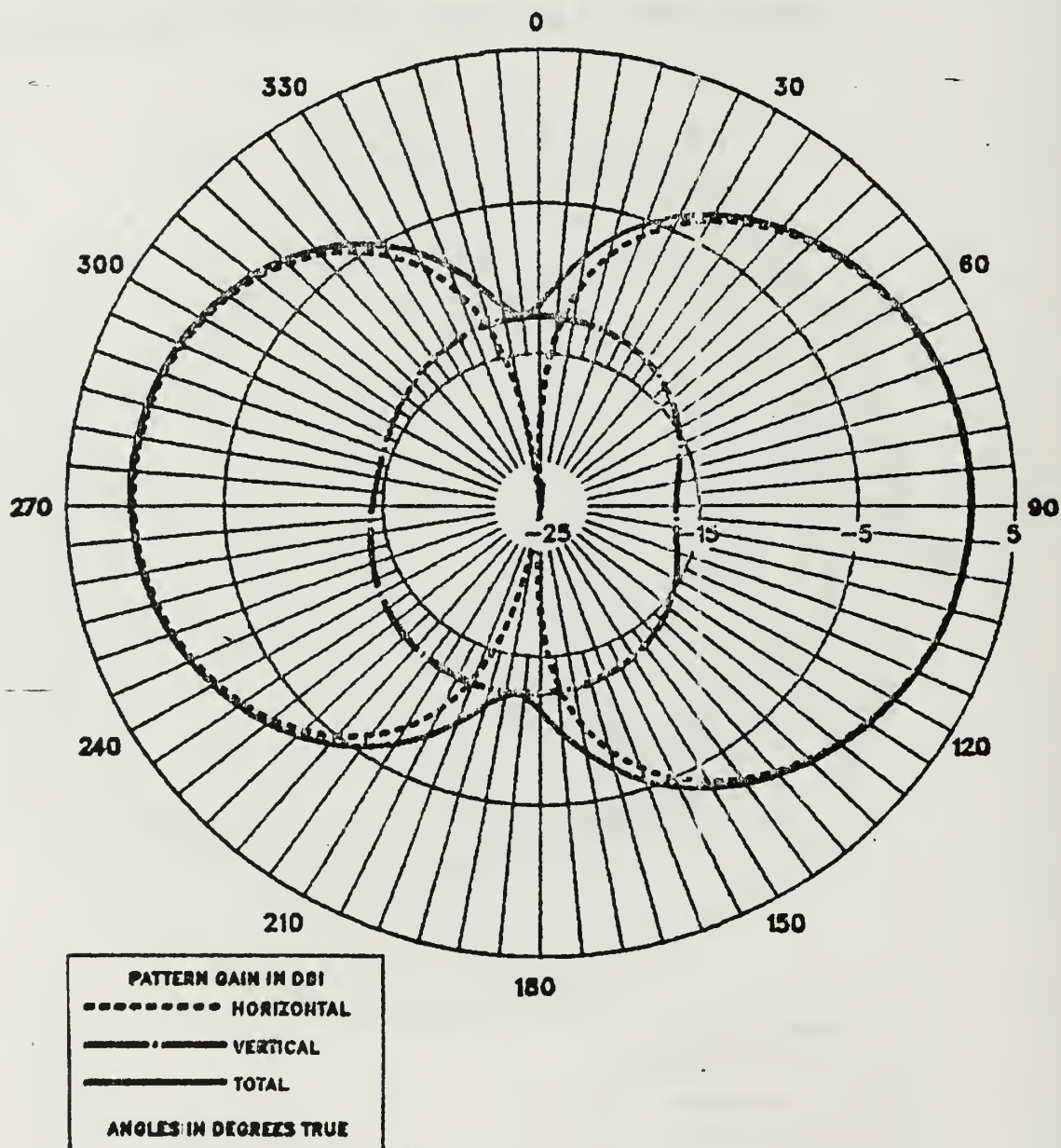
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, $\Phi=45$



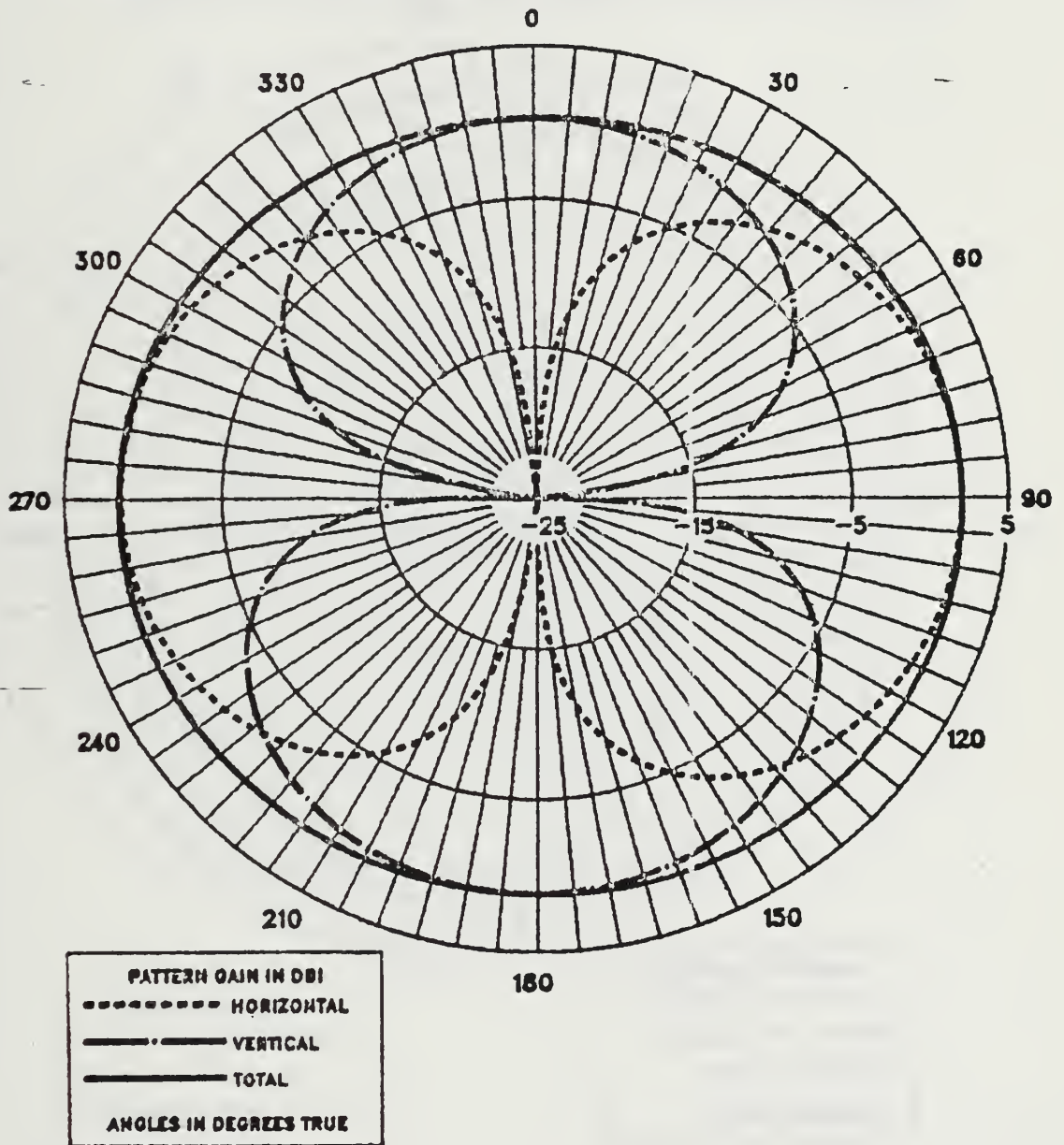
H65 IGUIANA DATA RUN AT 8.984MHZ ON 8/24/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



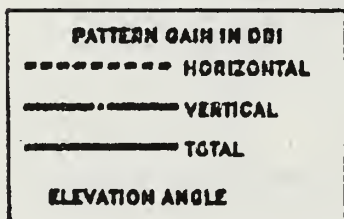
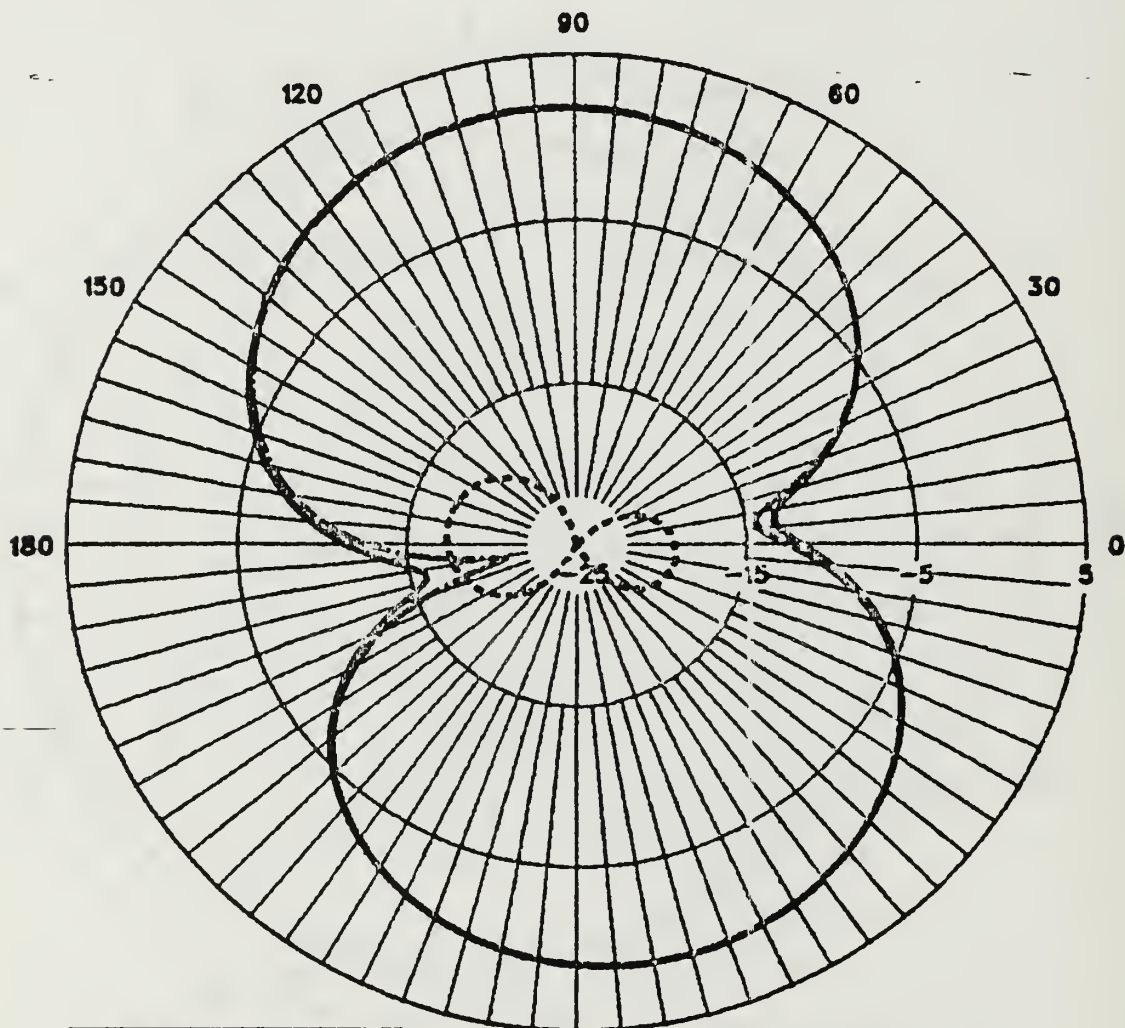
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



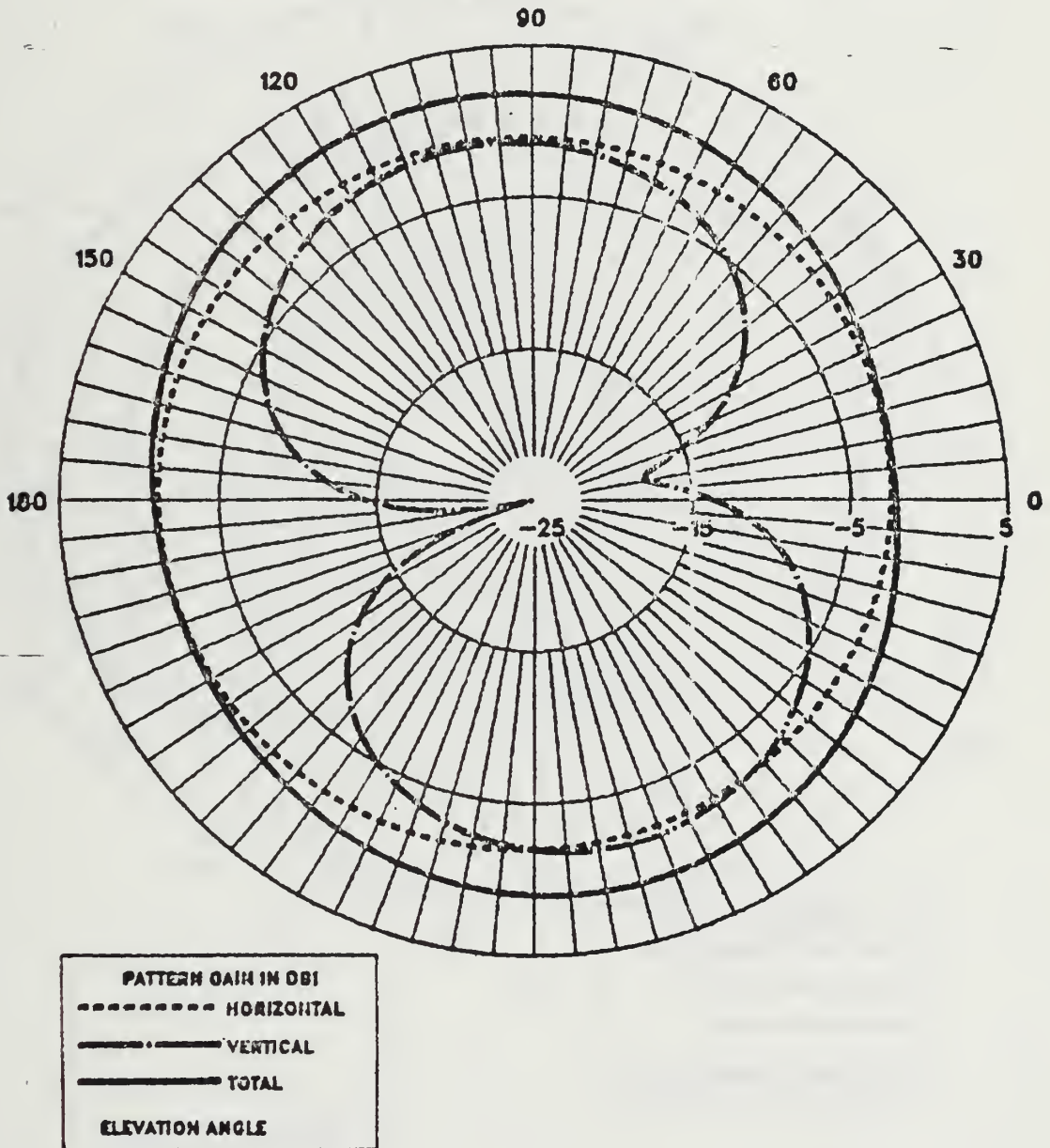
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



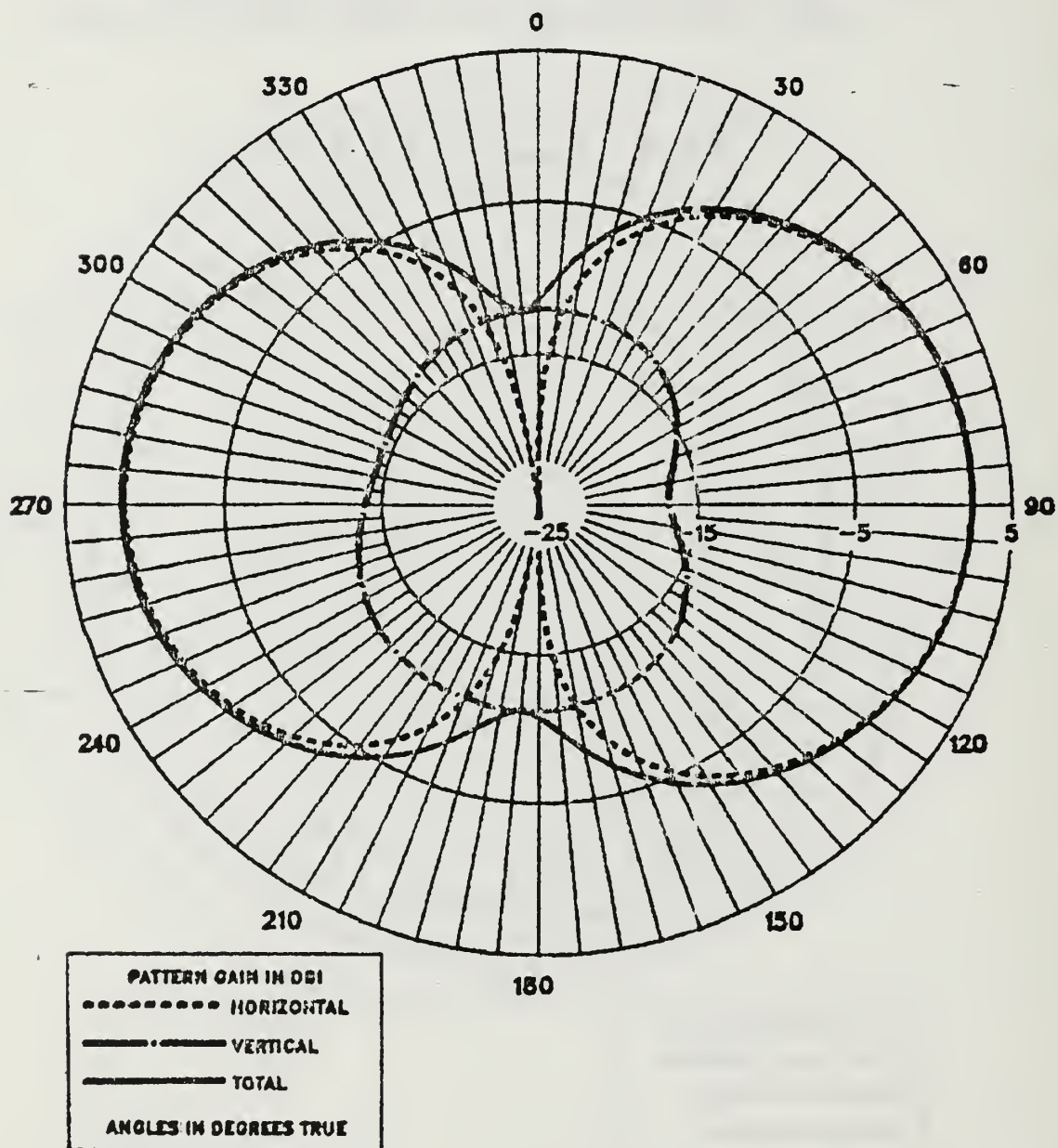
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



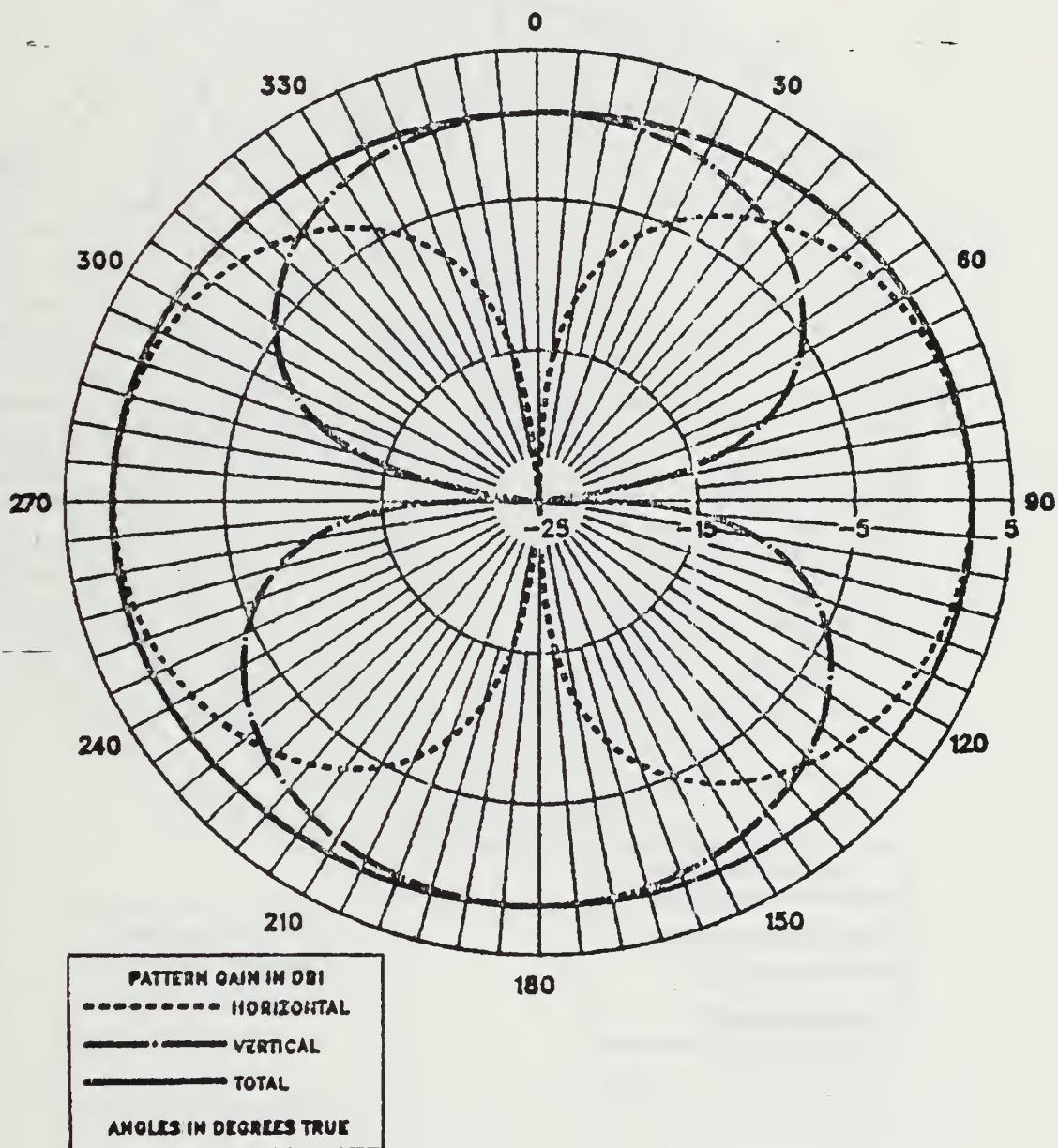
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



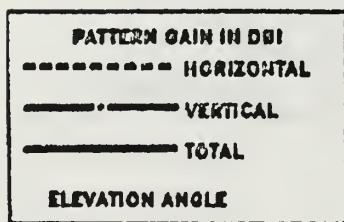
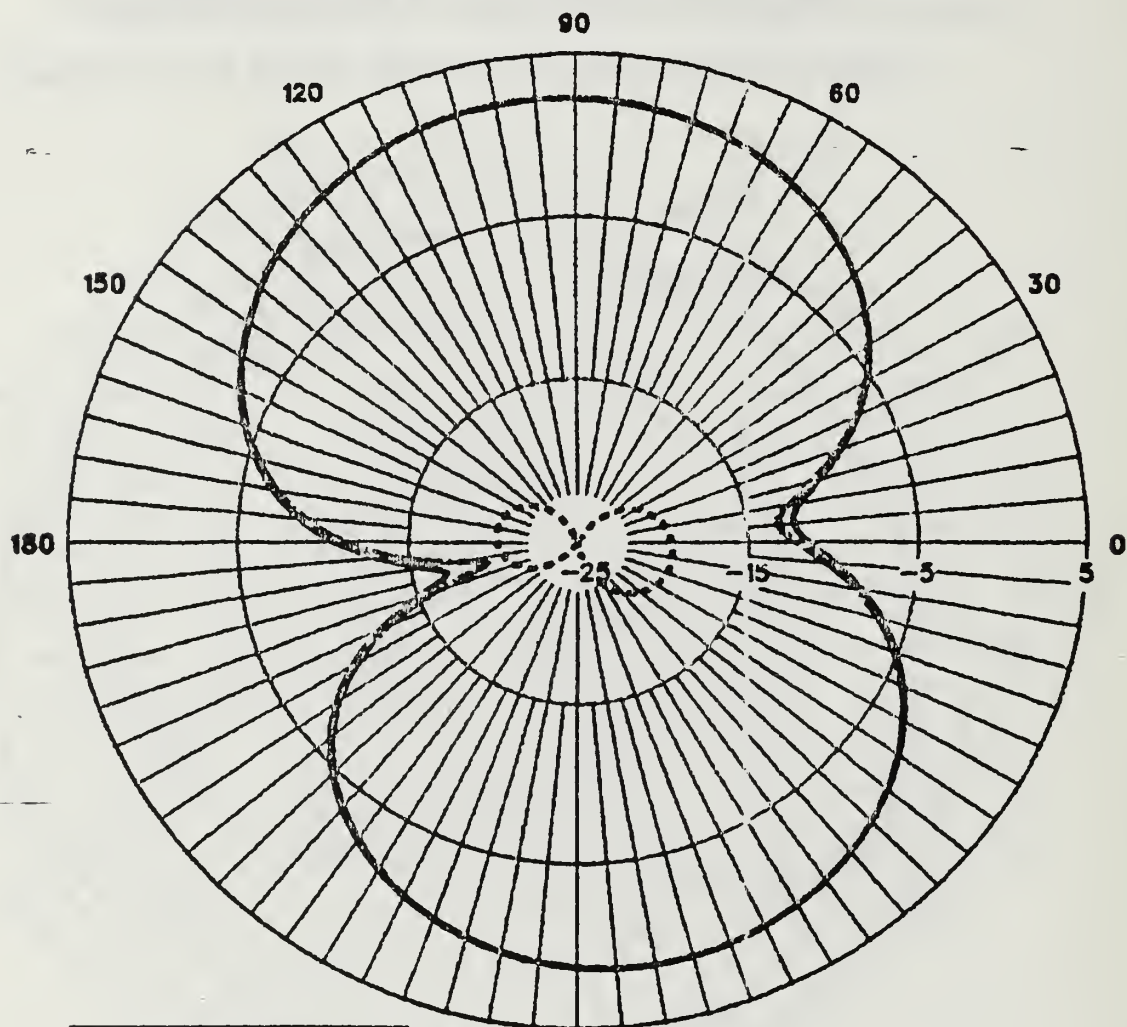
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=26



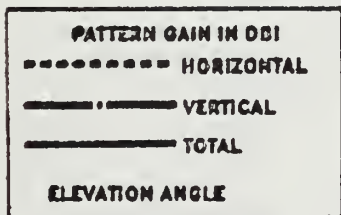
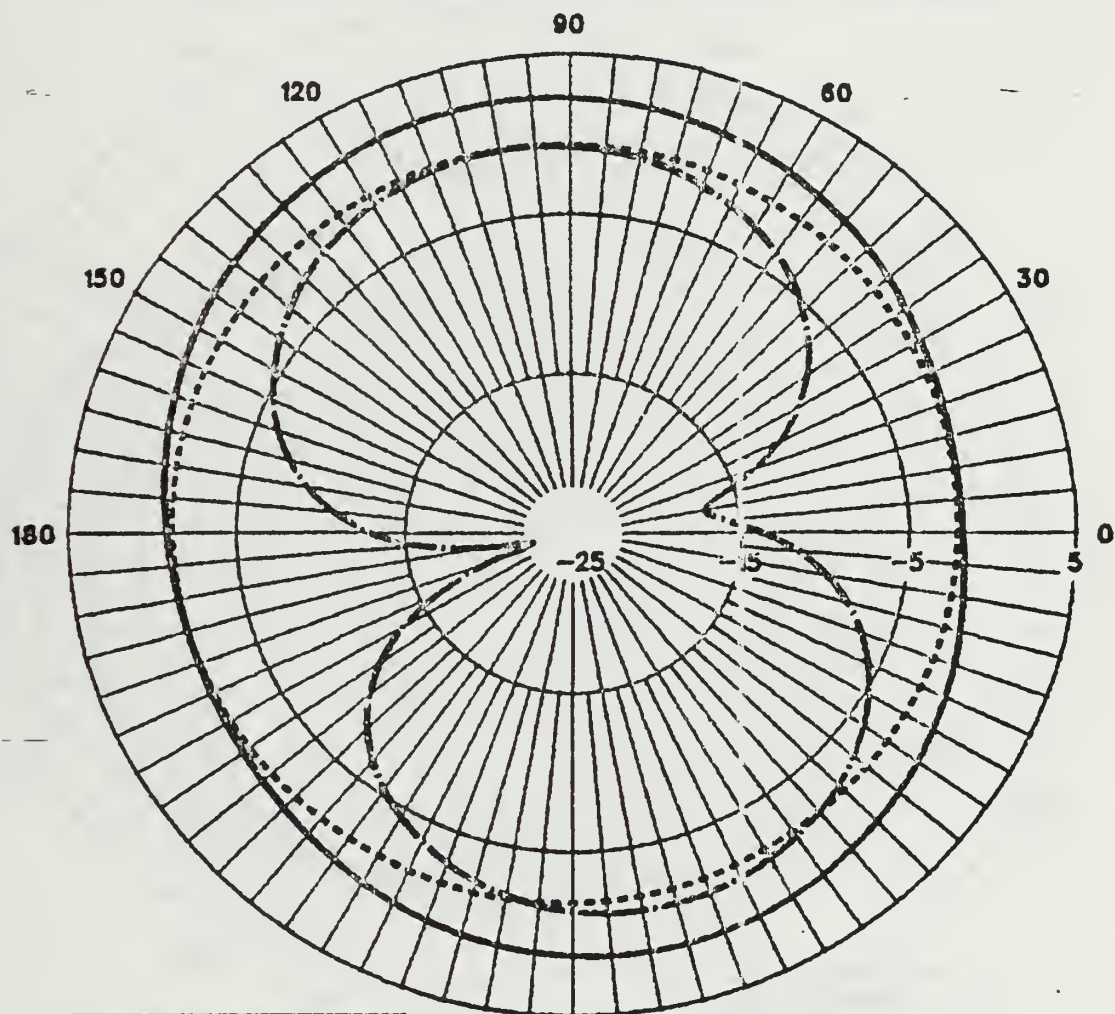
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=0



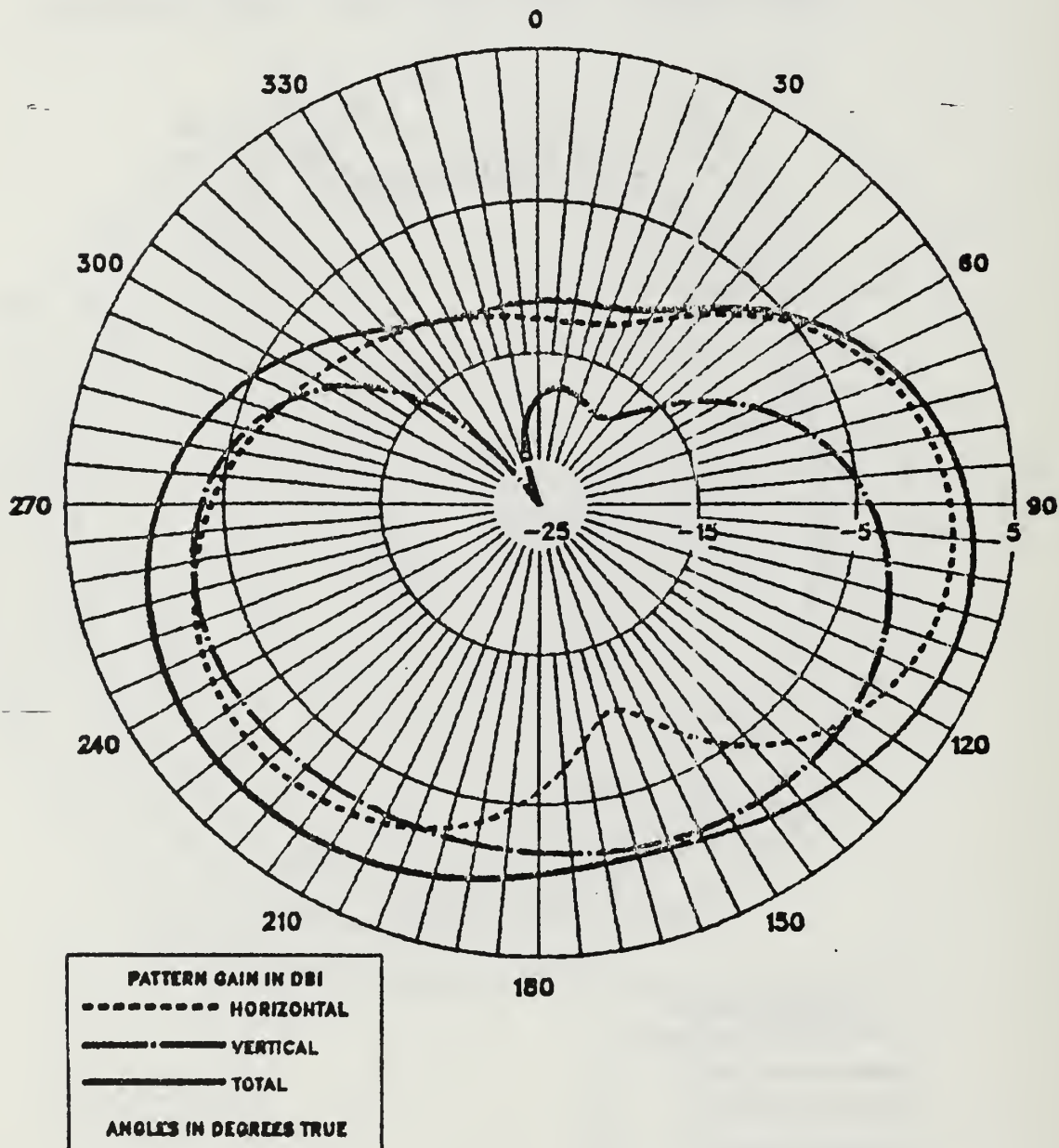
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=45



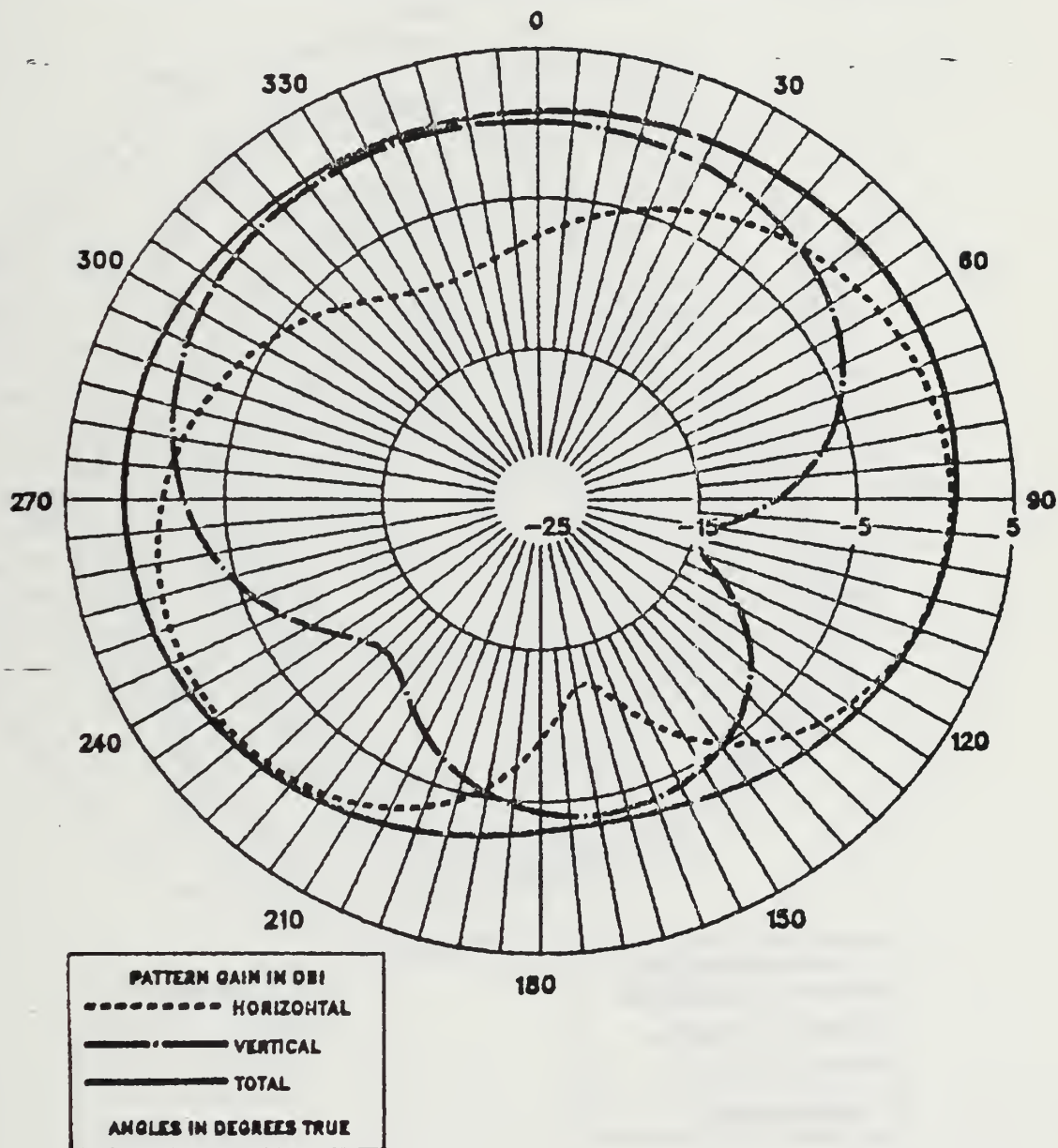
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



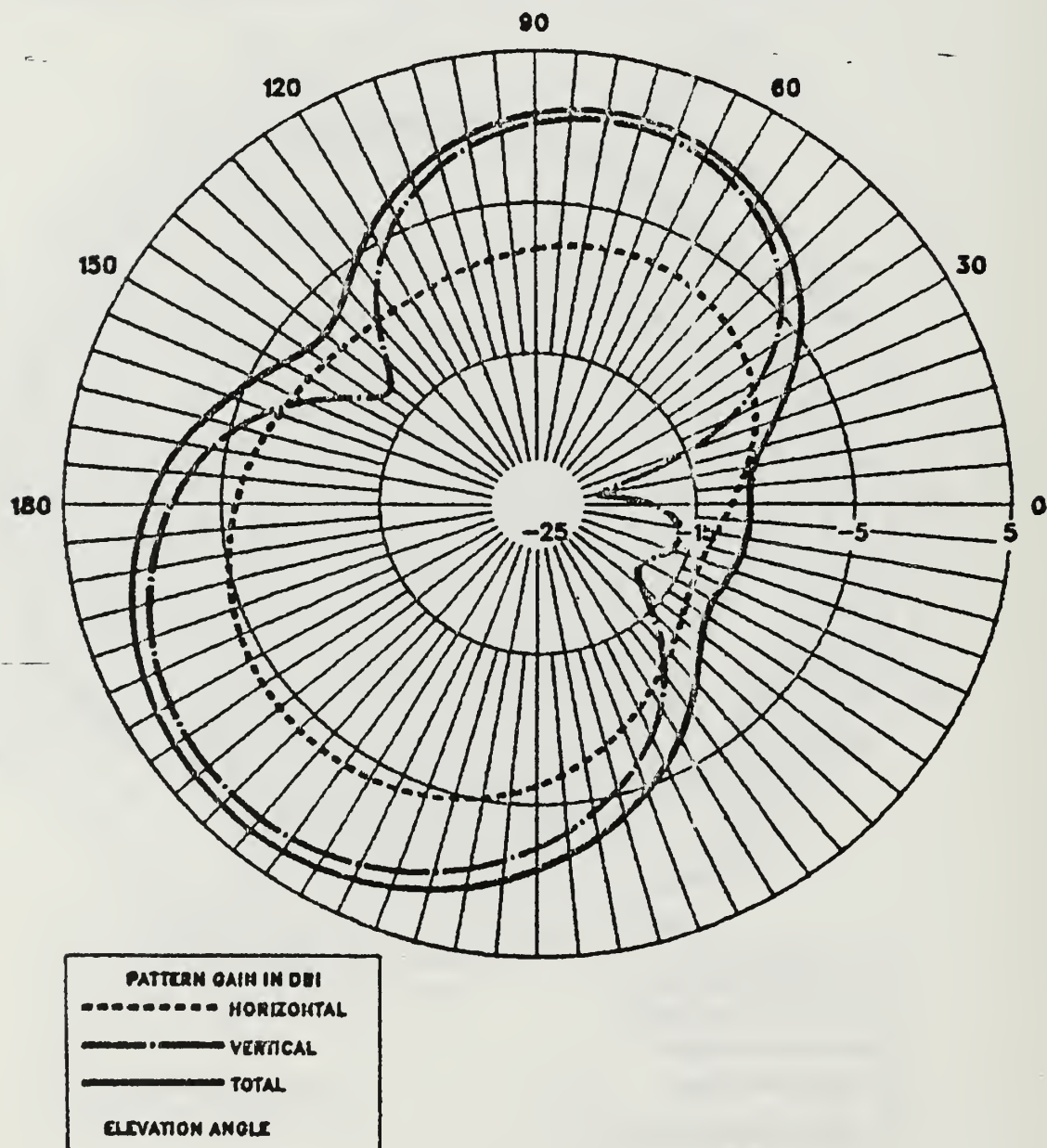
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



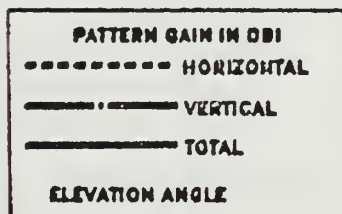
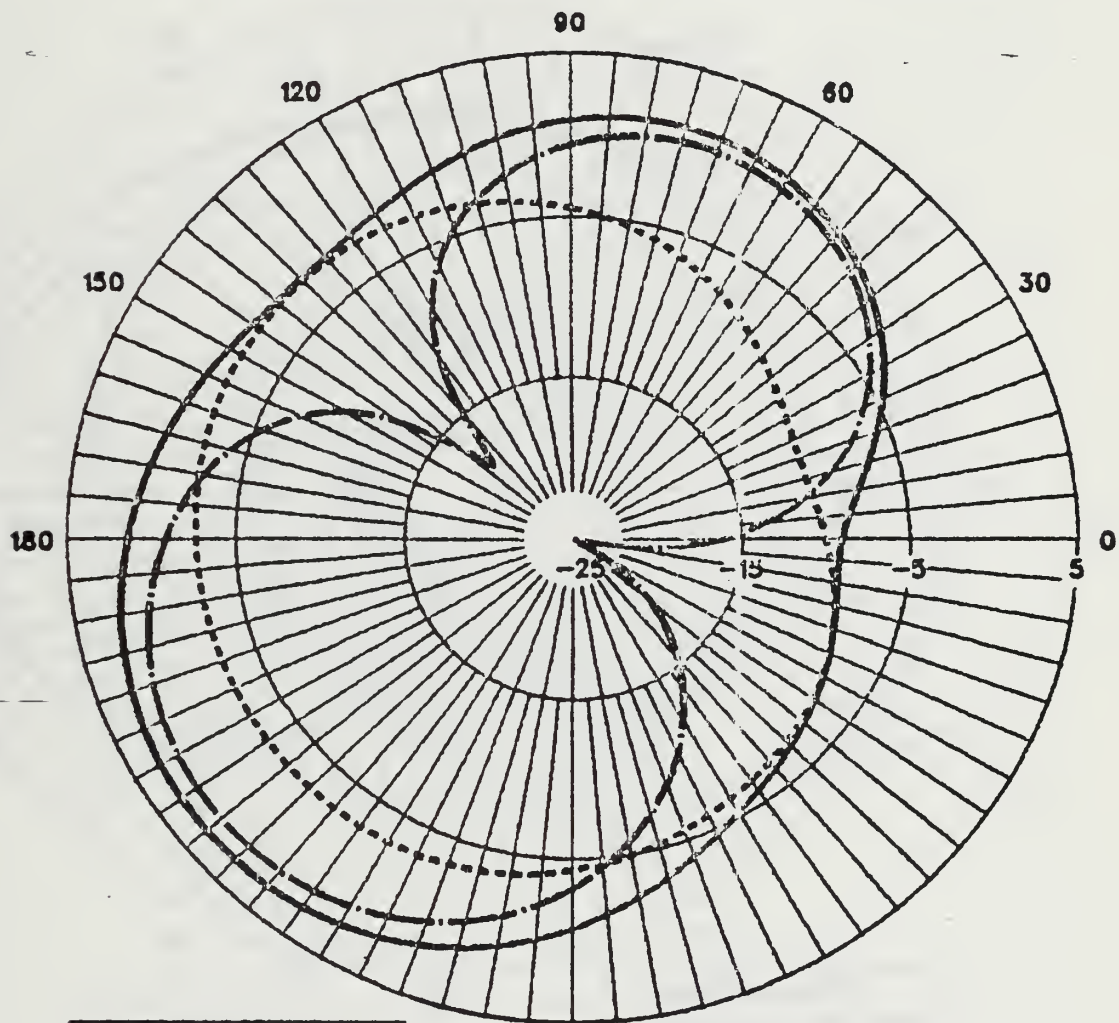
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



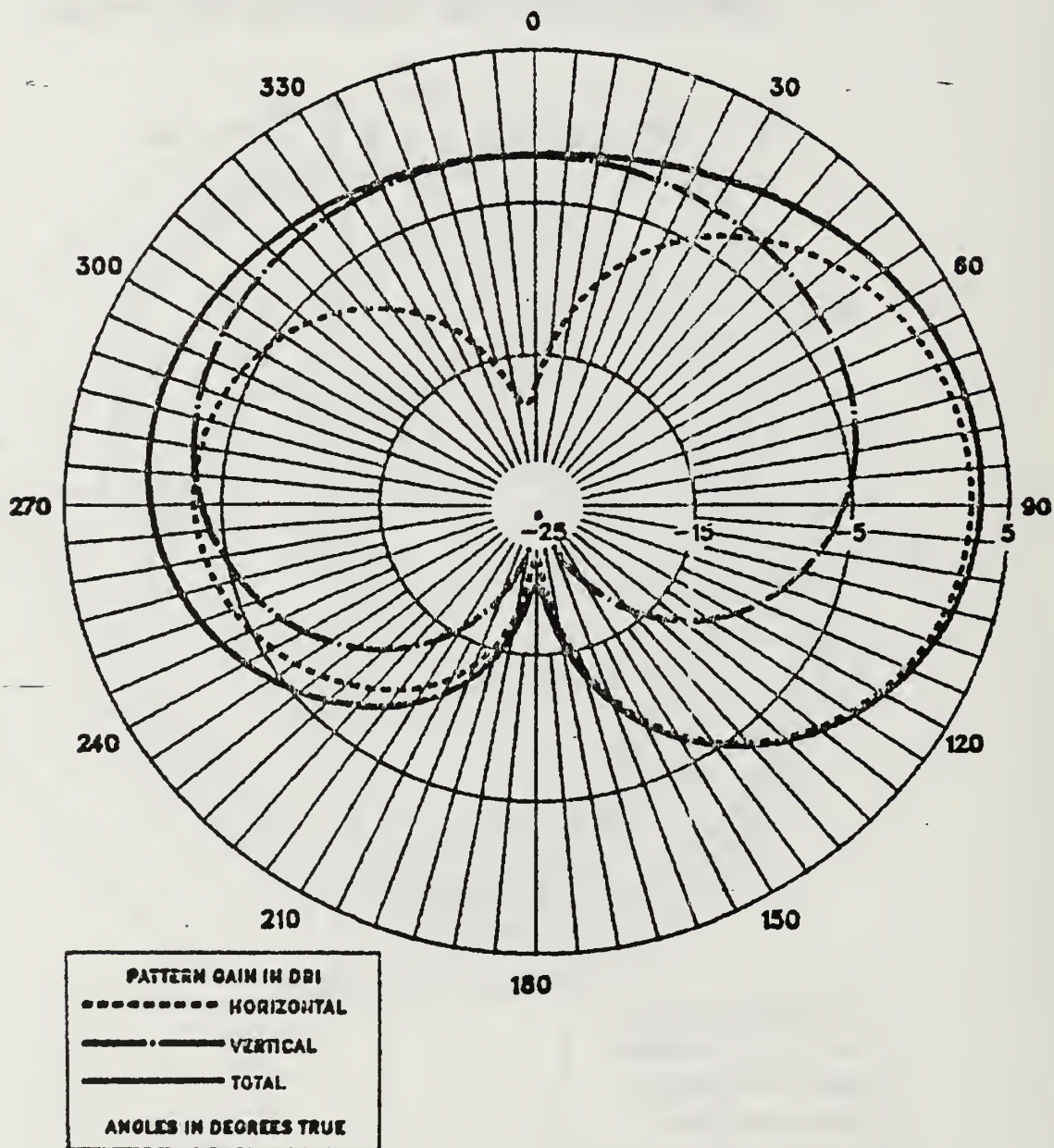
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



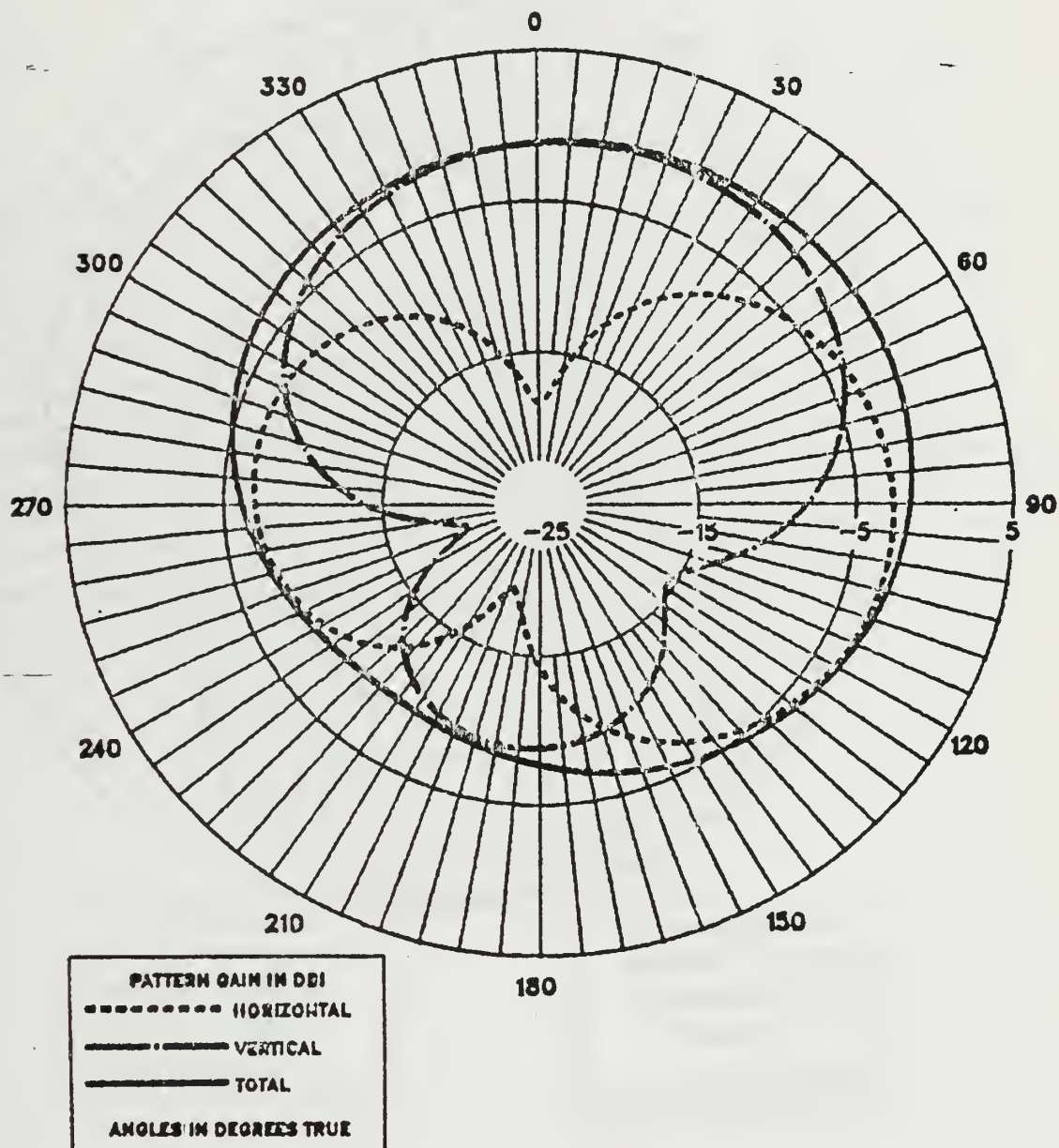
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



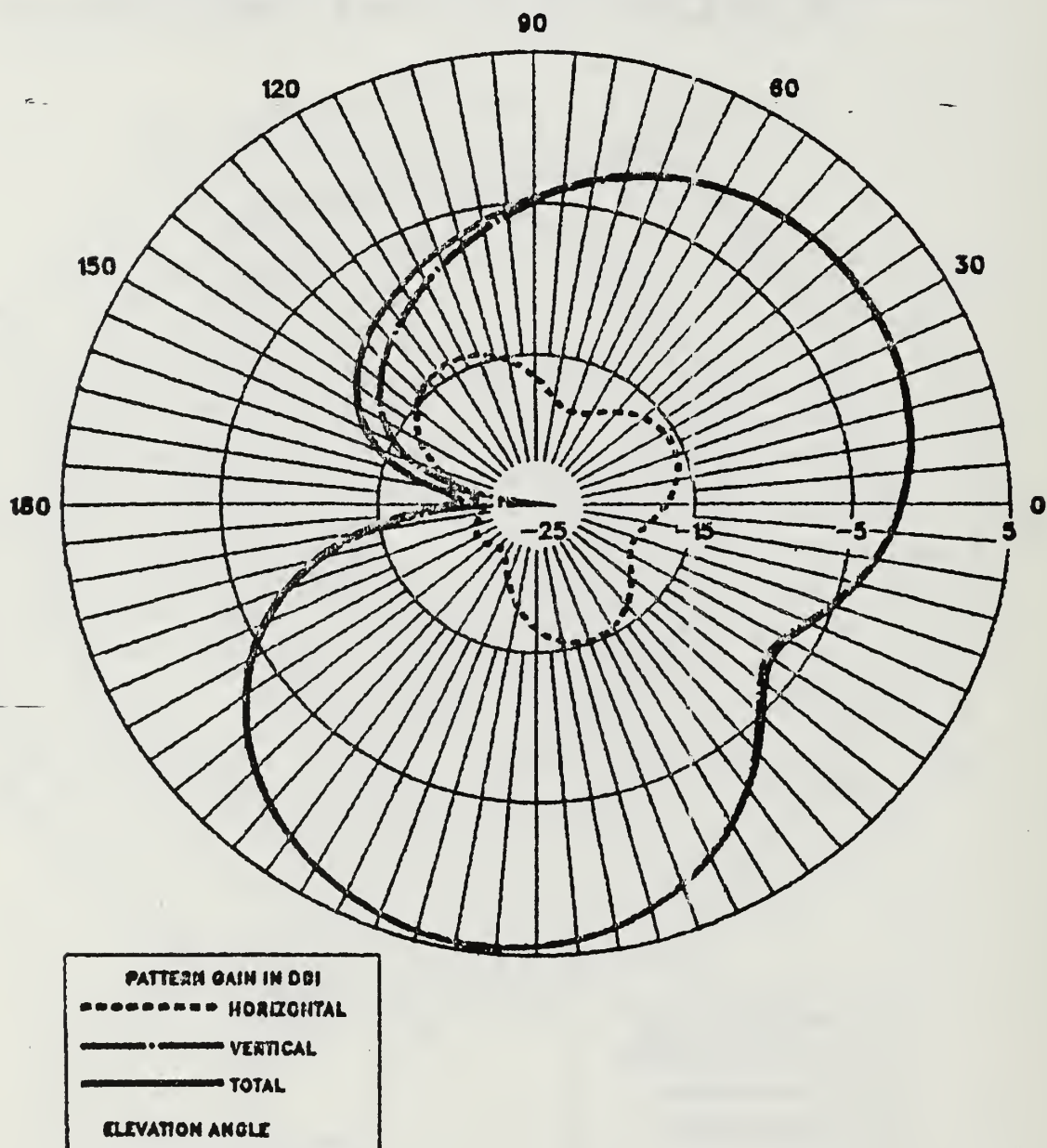
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



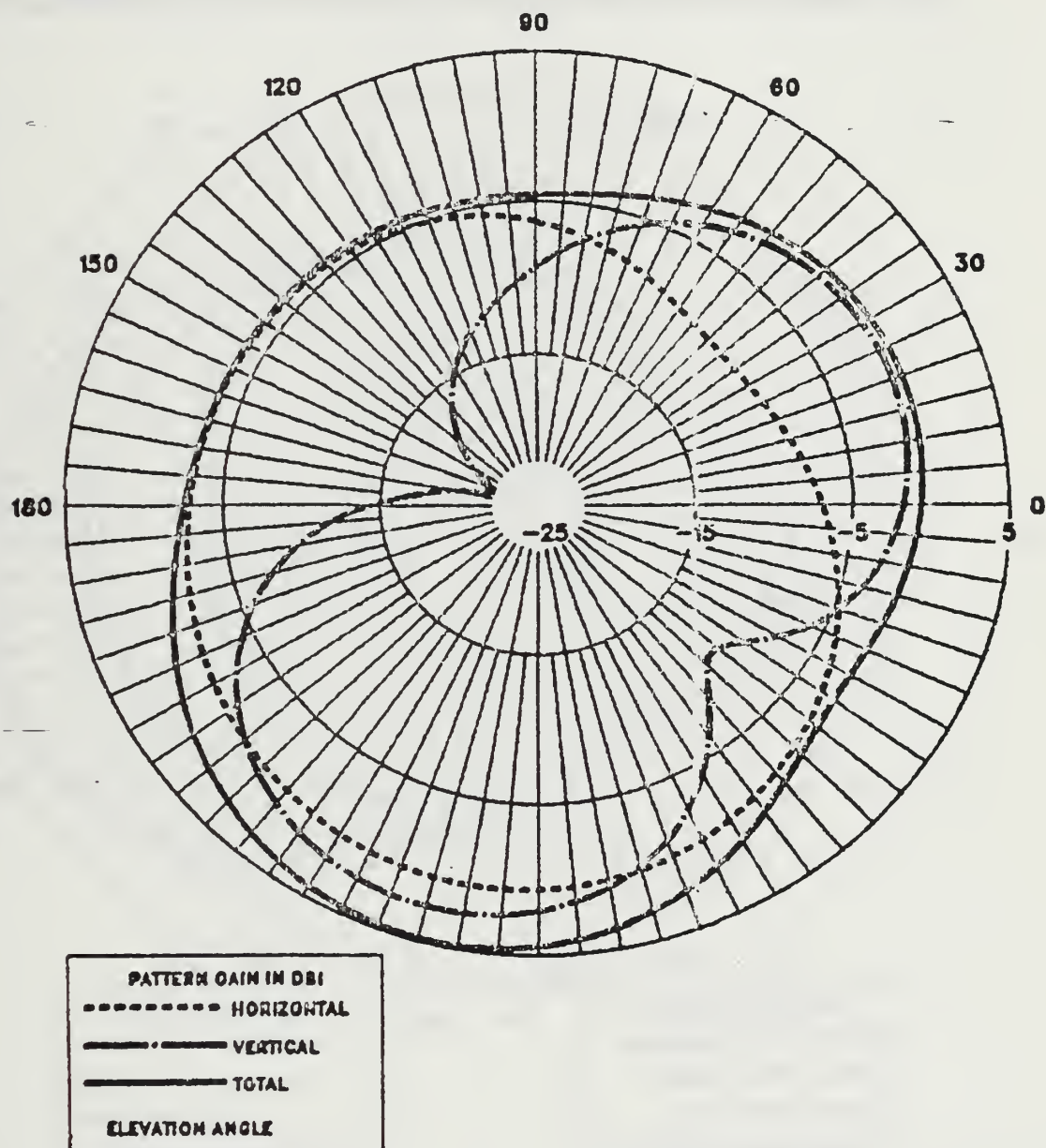
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



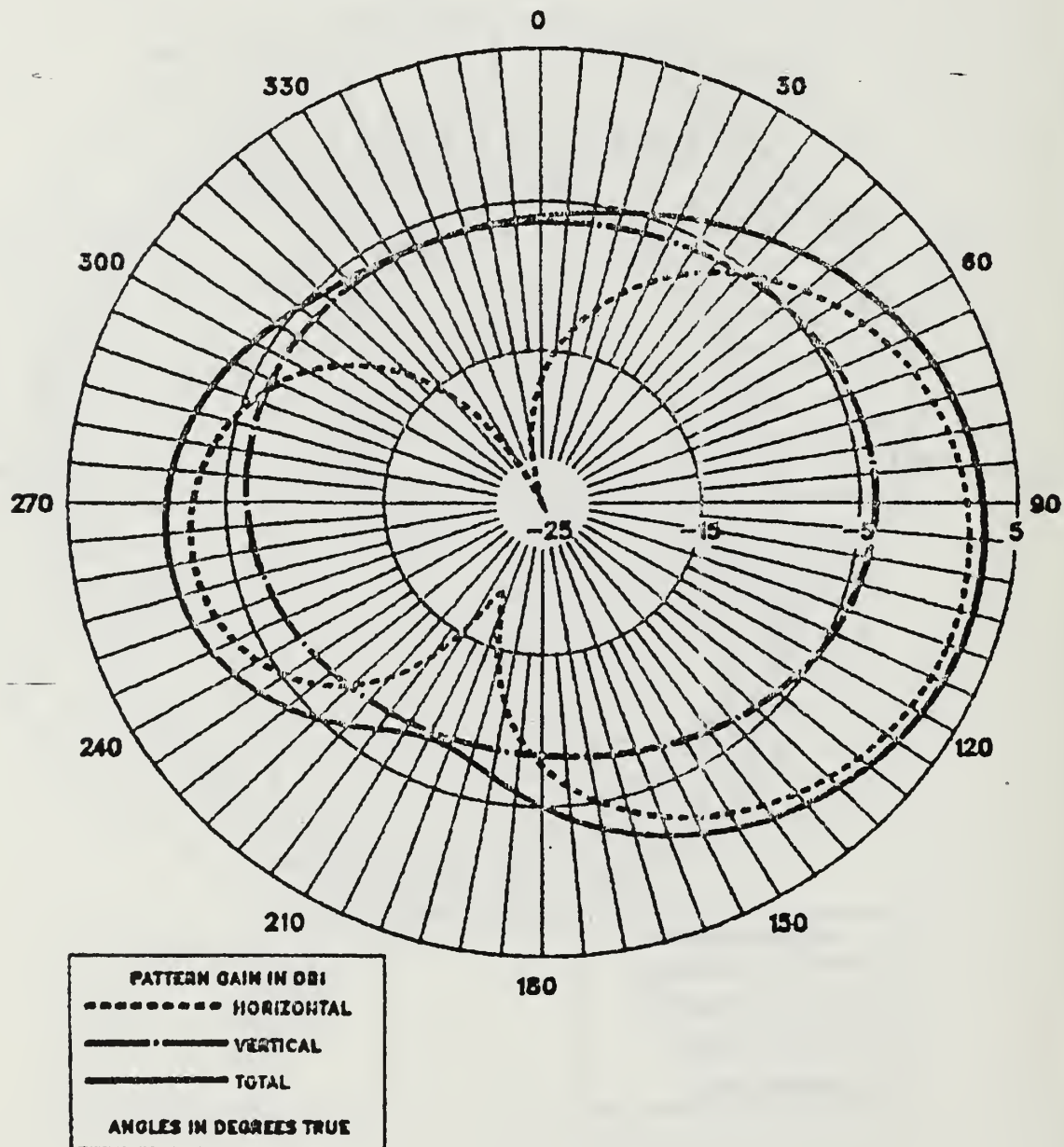
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COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



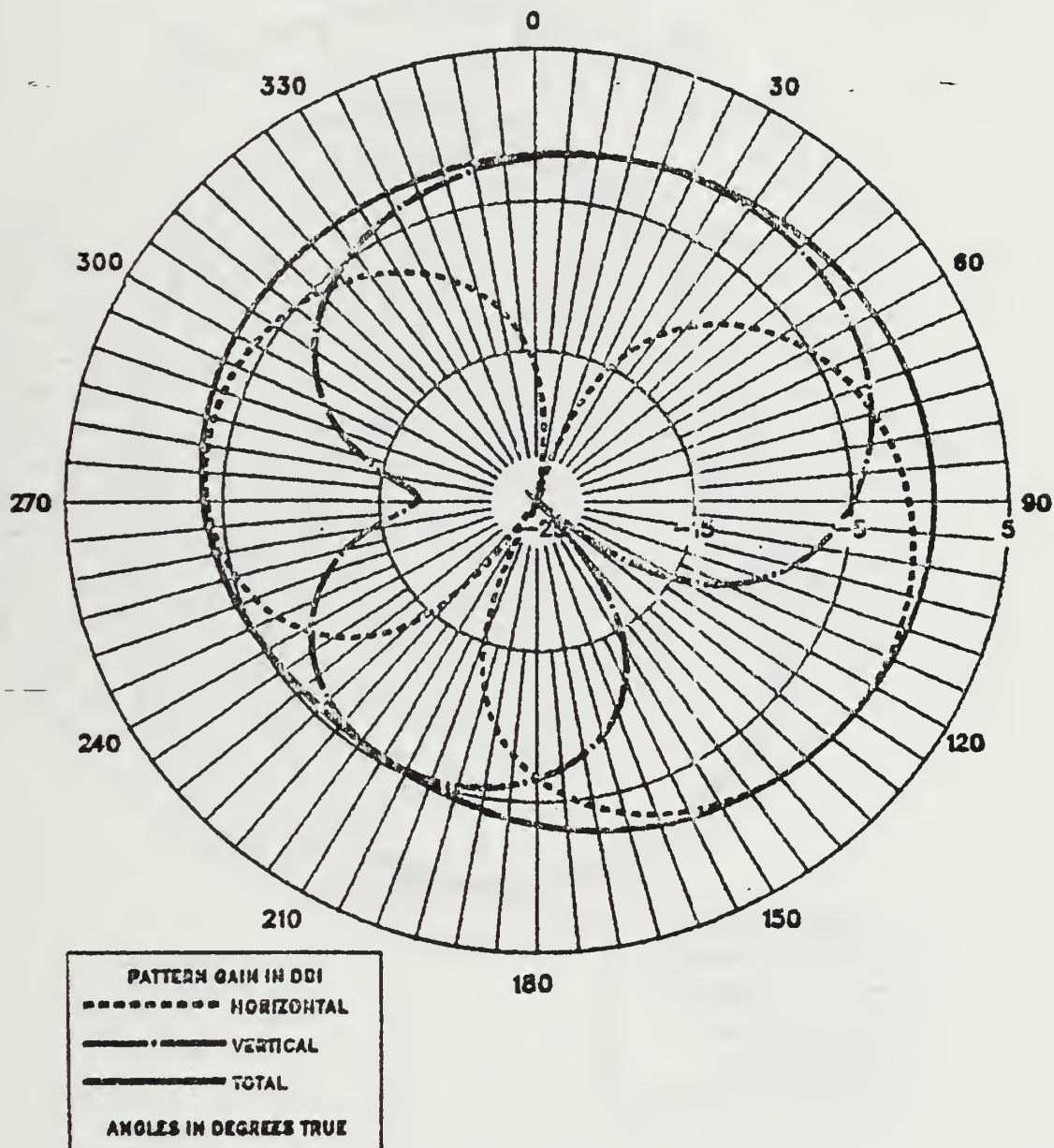
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



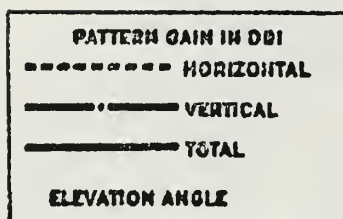
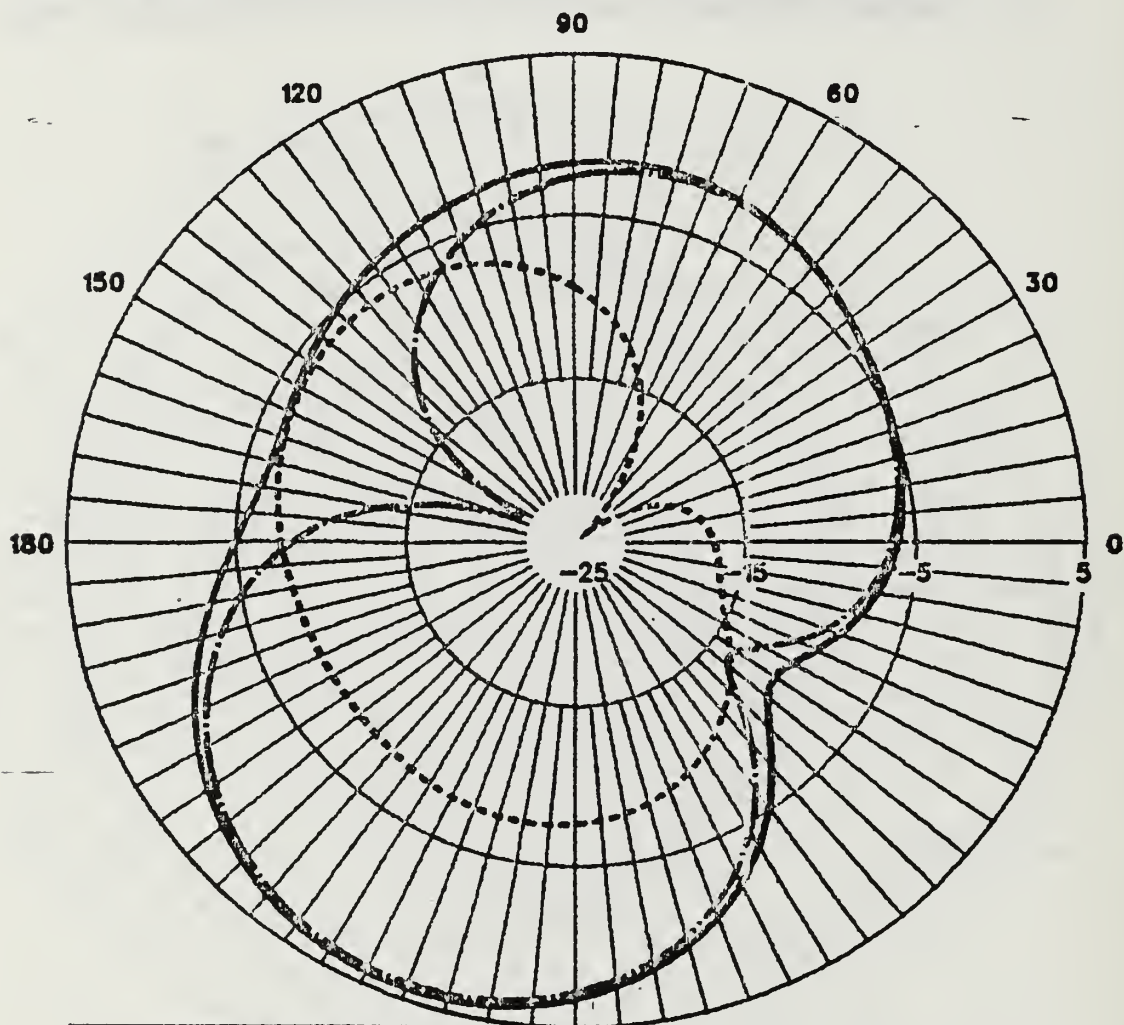
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



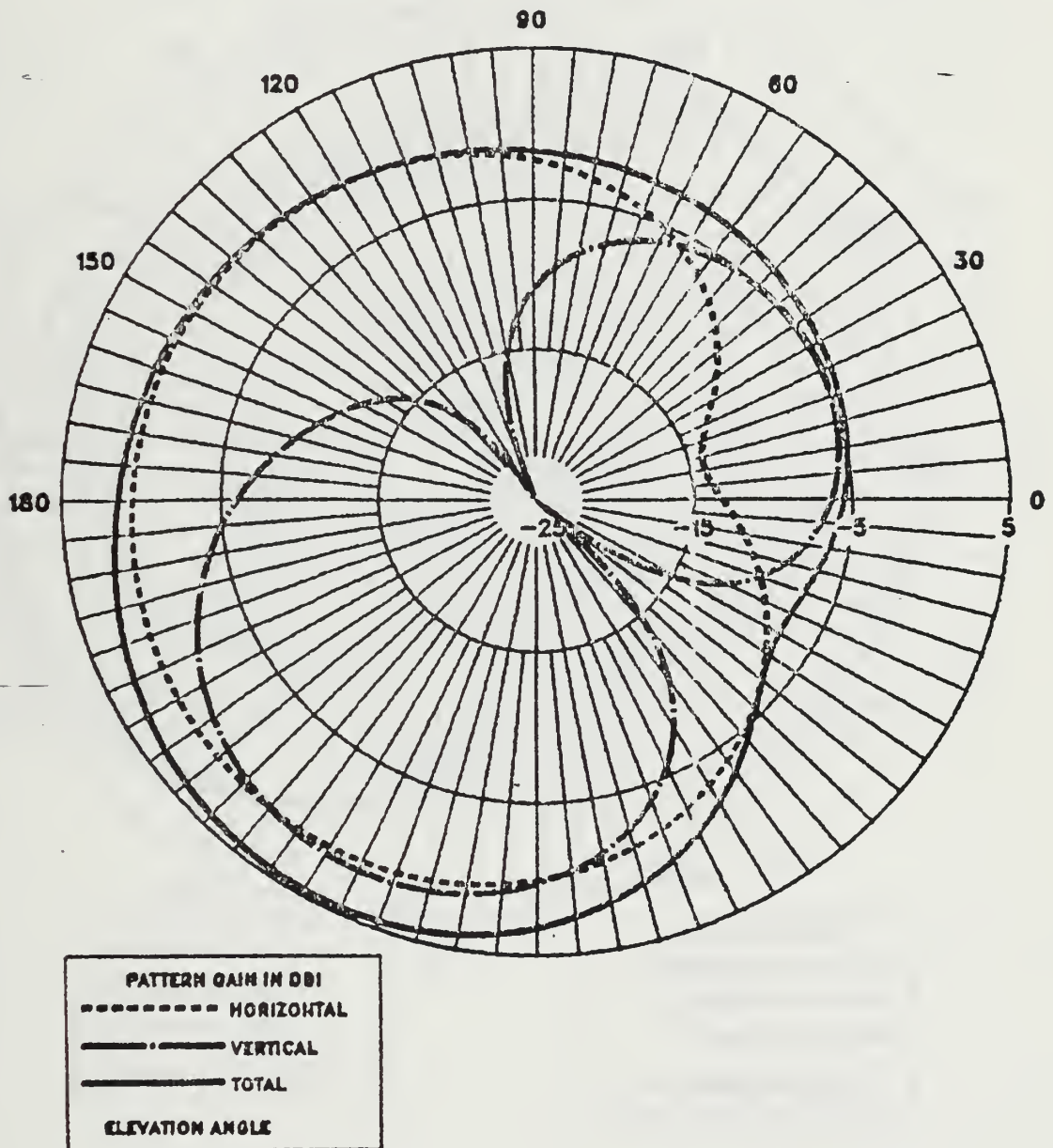
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



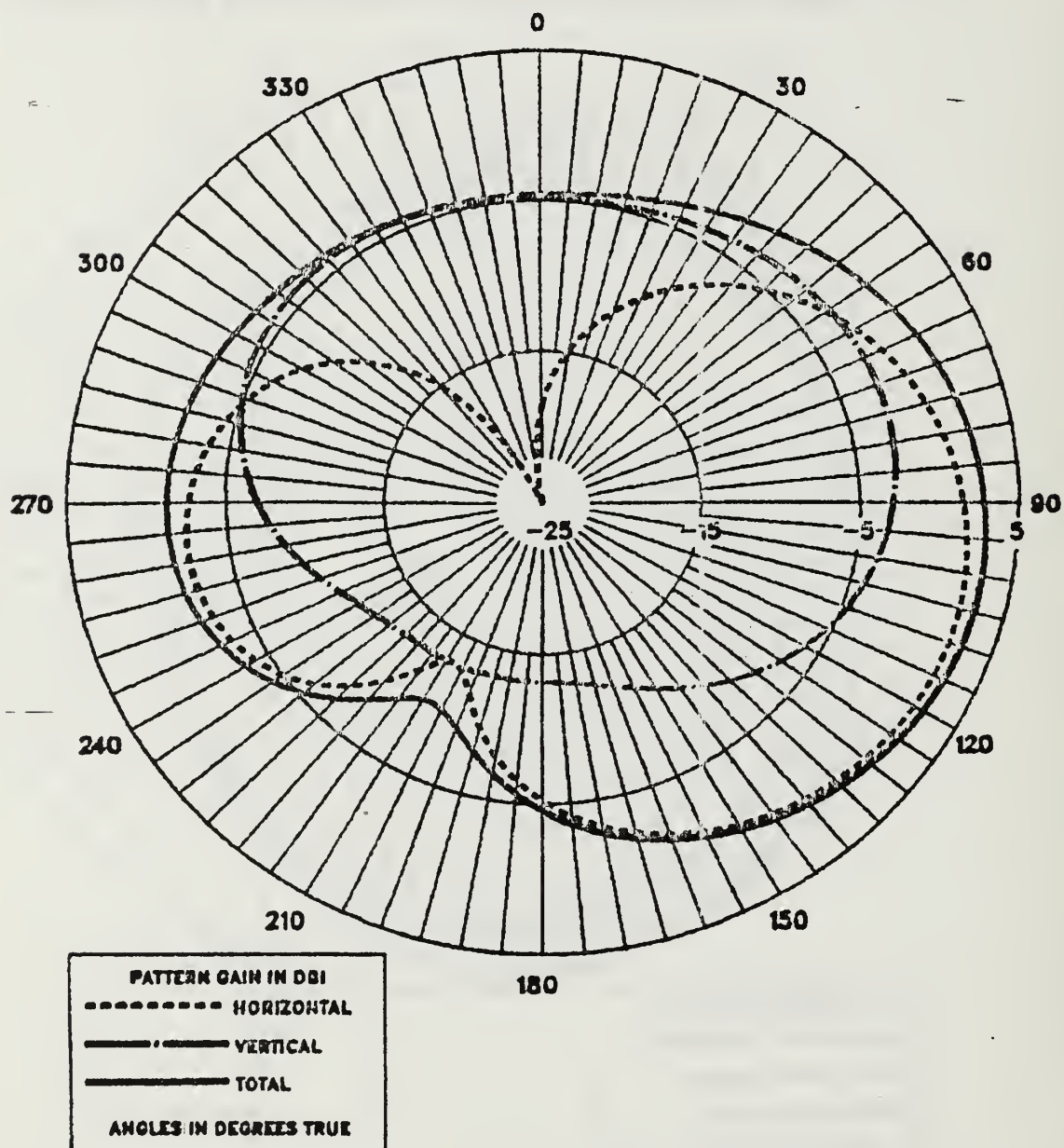
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ARMY-TYPE TUGE ANT, FREE SPACE, VERT CUT, PHI=45



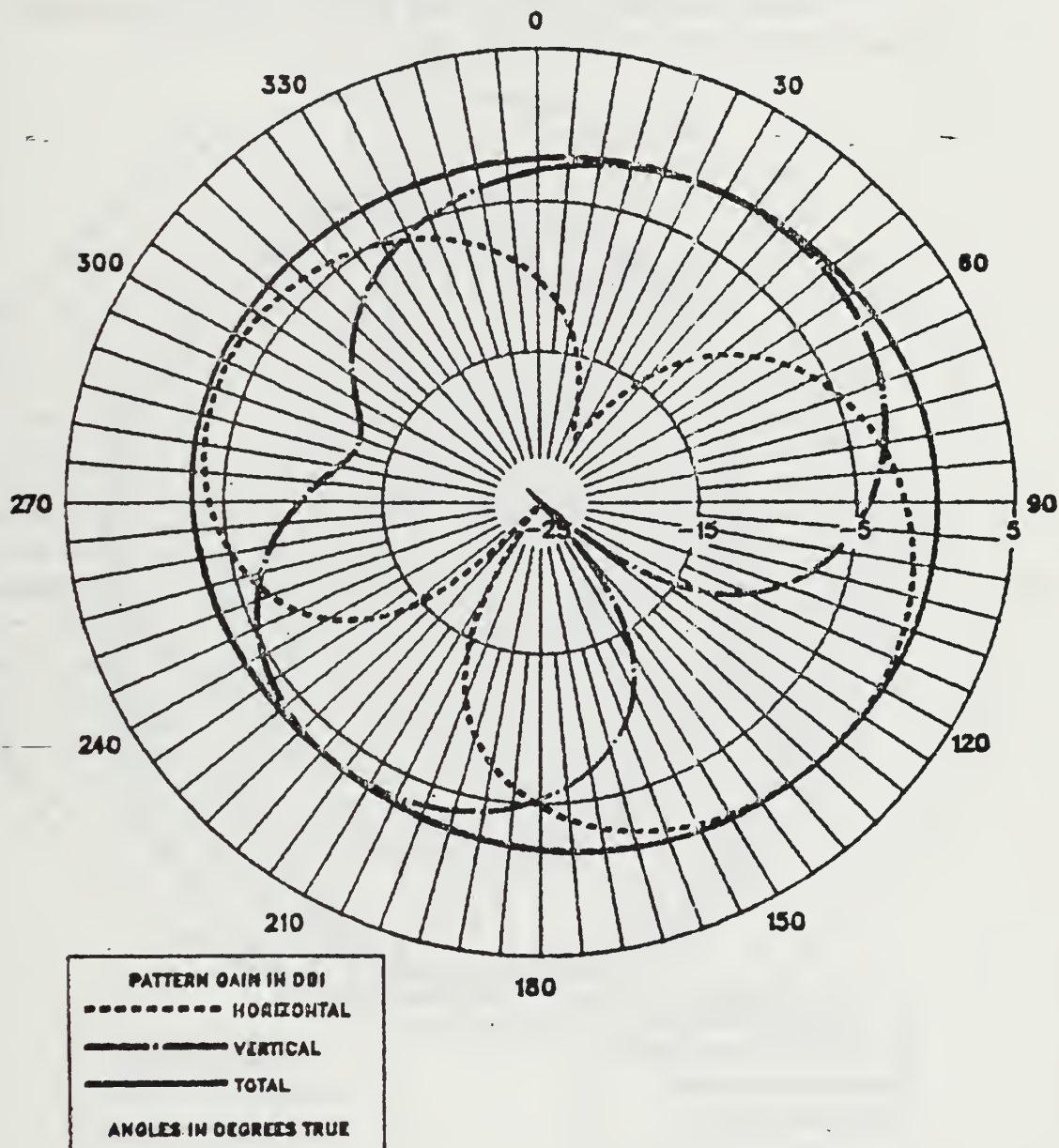
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



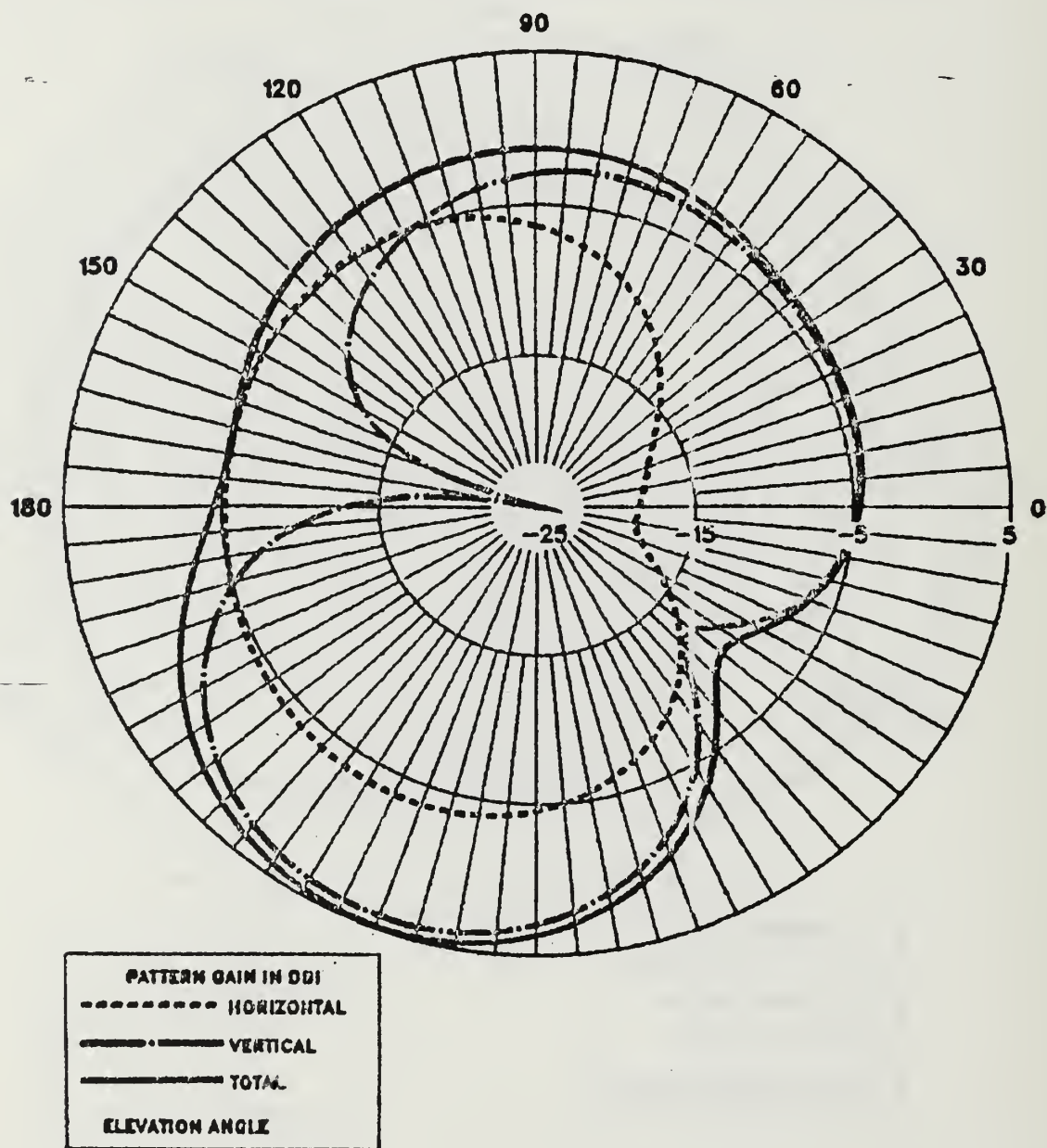
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=26



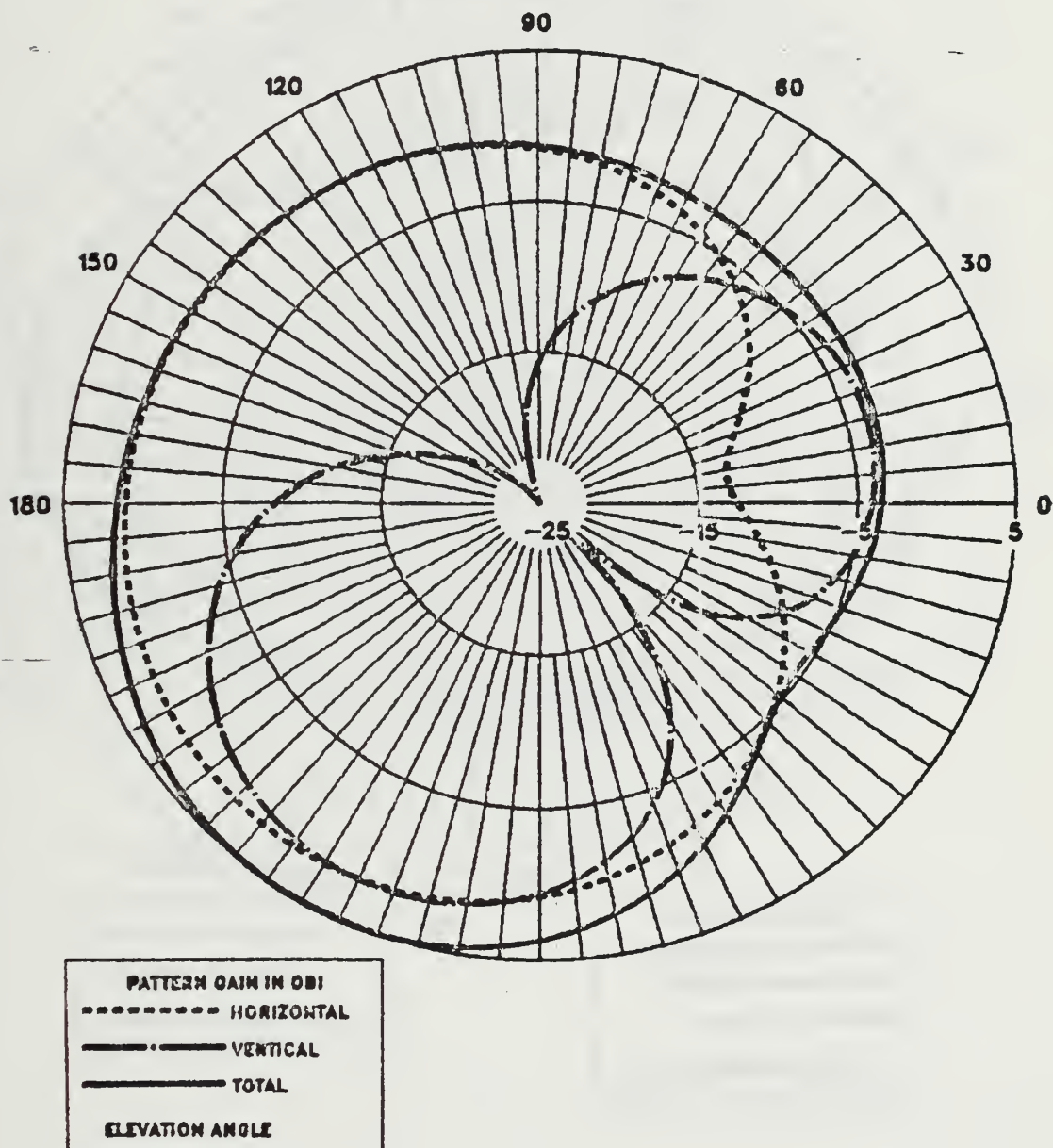
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LONG SHUNTED LOOP, FREE SPACE, VERT CUT, $\Phi=0$



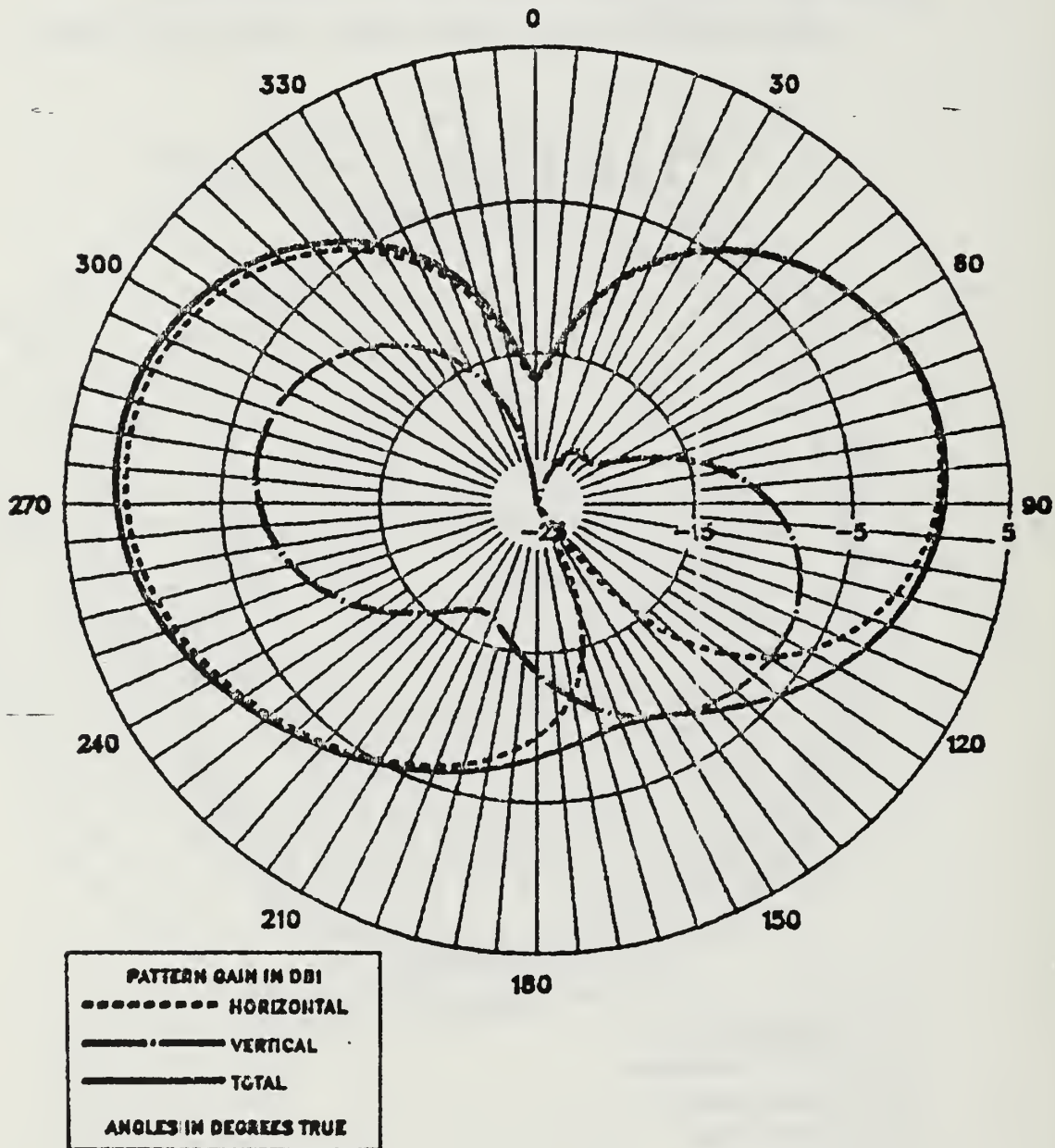
H65 IGUANA DATA RUN AT 13.974MHZ ON 8/25/87

LONG SHUNTED LOOP, FREE SPACE, VERT CUT, $\Phi=45$



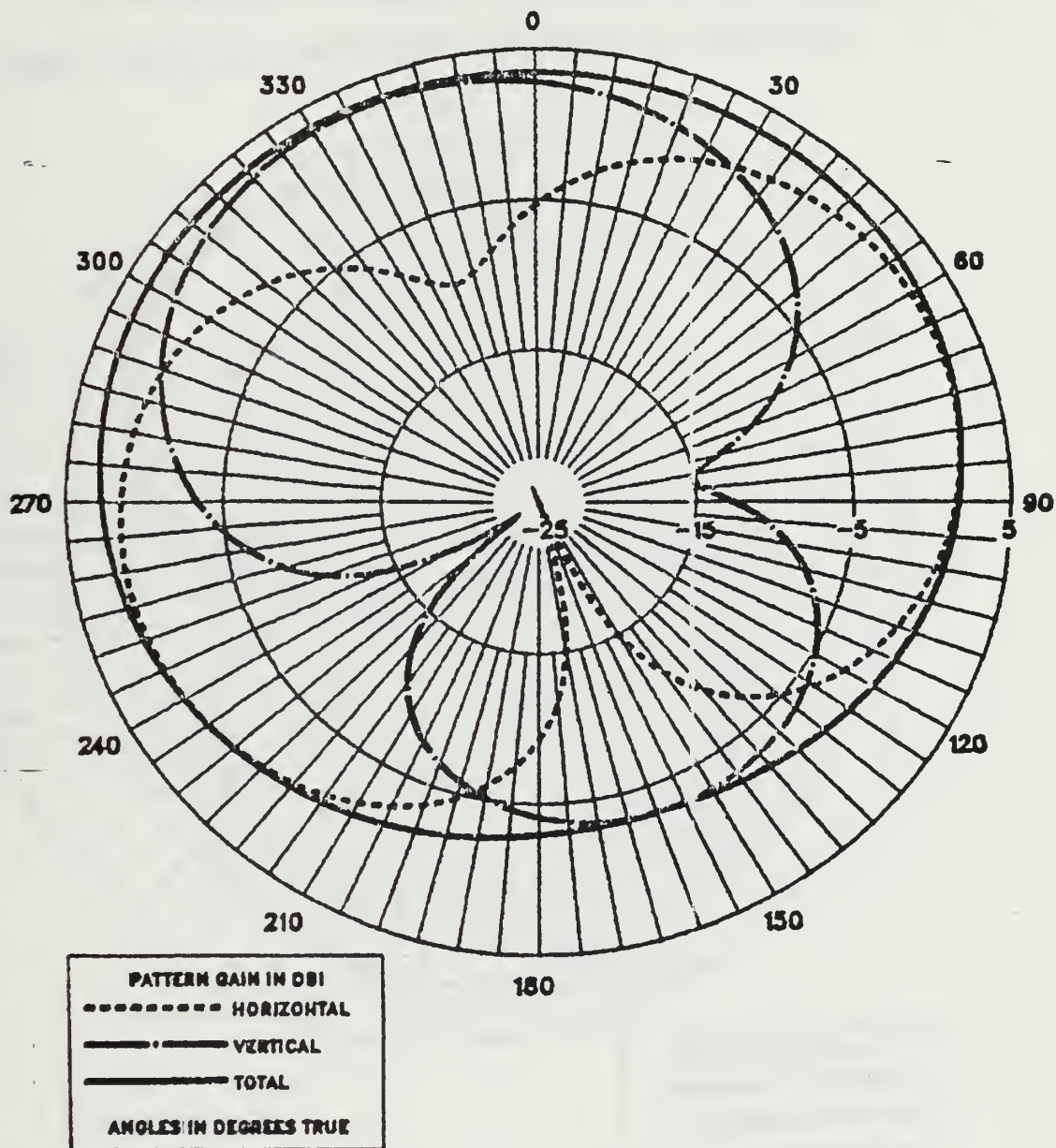
H65 IGUANA DATA RUN AT 18.1MHZ ON 8/18/87

LW SPACED 12" FROM A/C, FREE SPACE, HORIZ CUT, THETA=90



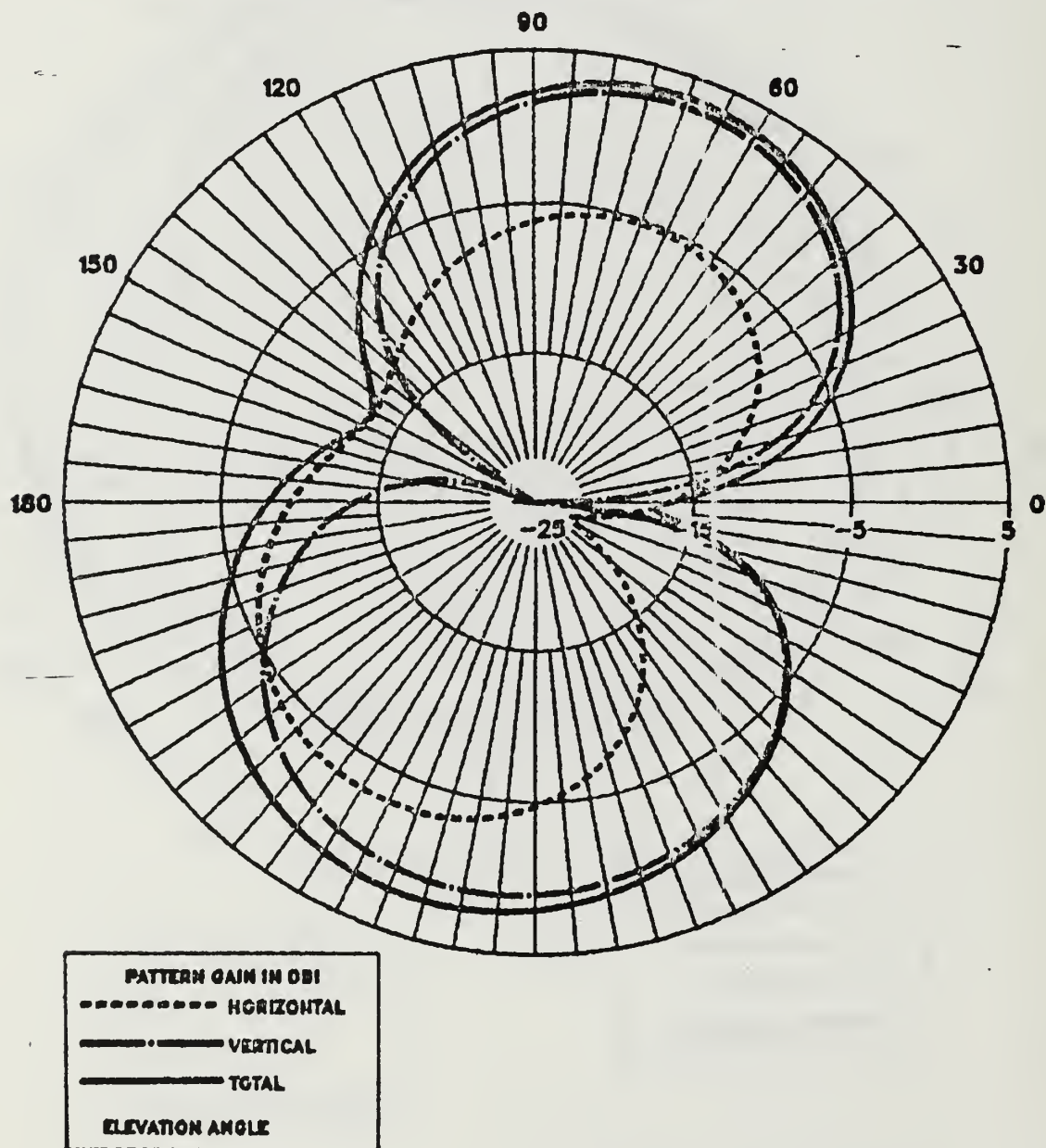
H65 IGUANA DATA RUN AT 18.1MHZ ON 8/18/87

LW SPACED 12" FROM A/C, FREE SPACE, HORIZ CUT, THETA=26



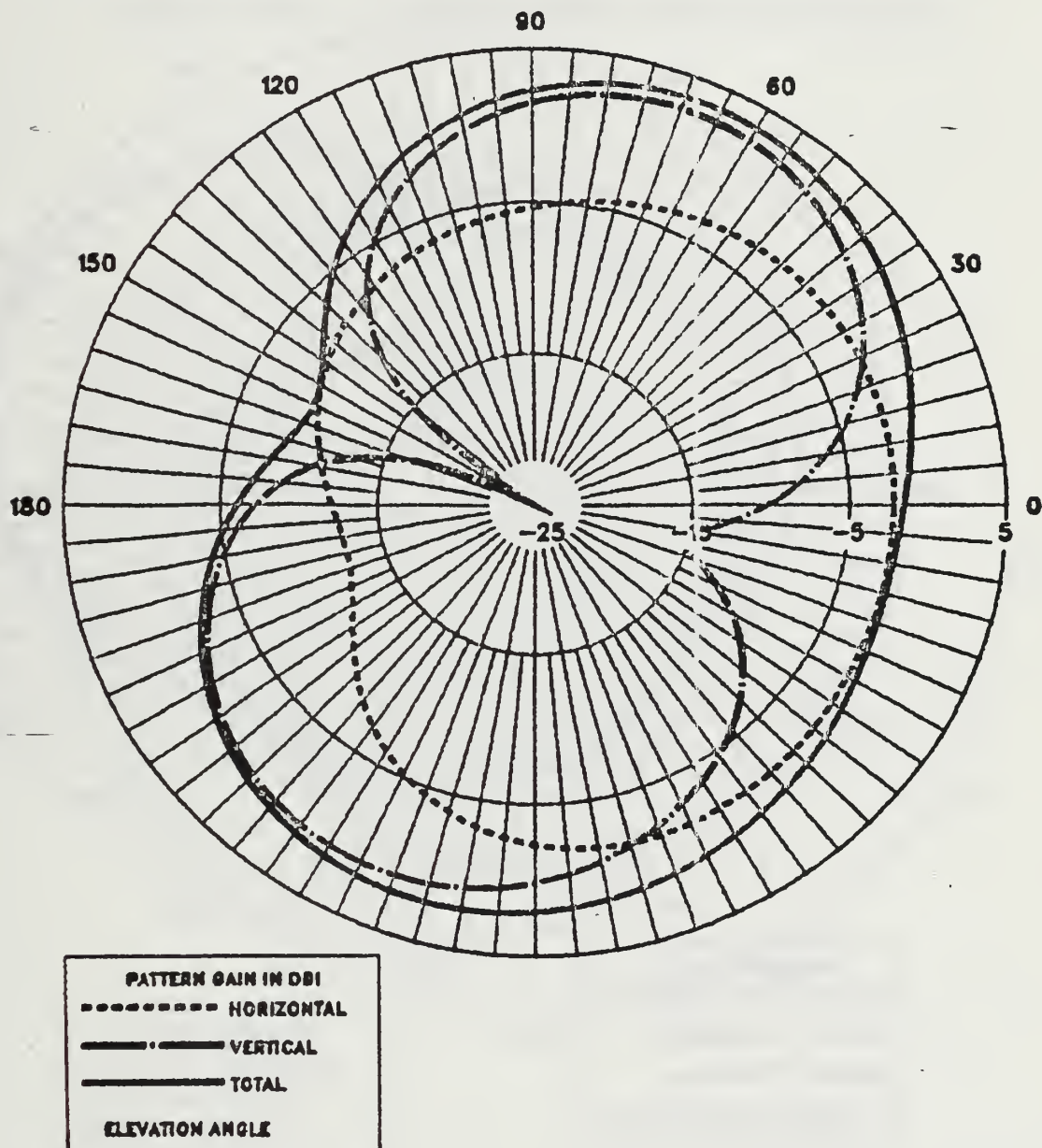
H65 IGUANA DATA RUN AT 18.1MHZ ON 8/18/87

LW SPACED 12" FROM A/C, FREE SPACE, VERT CUT, PHI=0



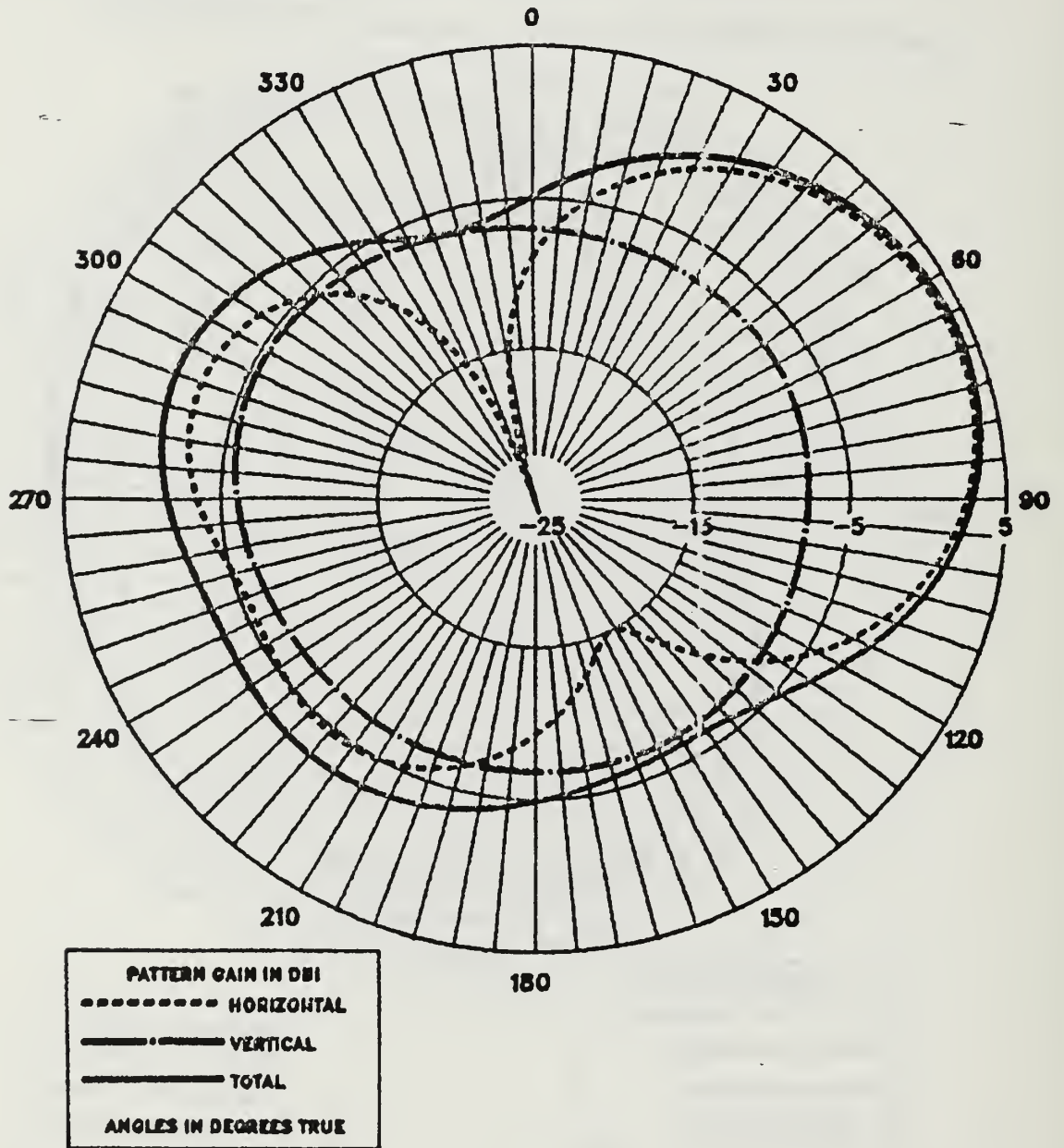
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LW SPACED 12" FROM A/C, FREE SPACE, VERT CUT, $\Phi=45$



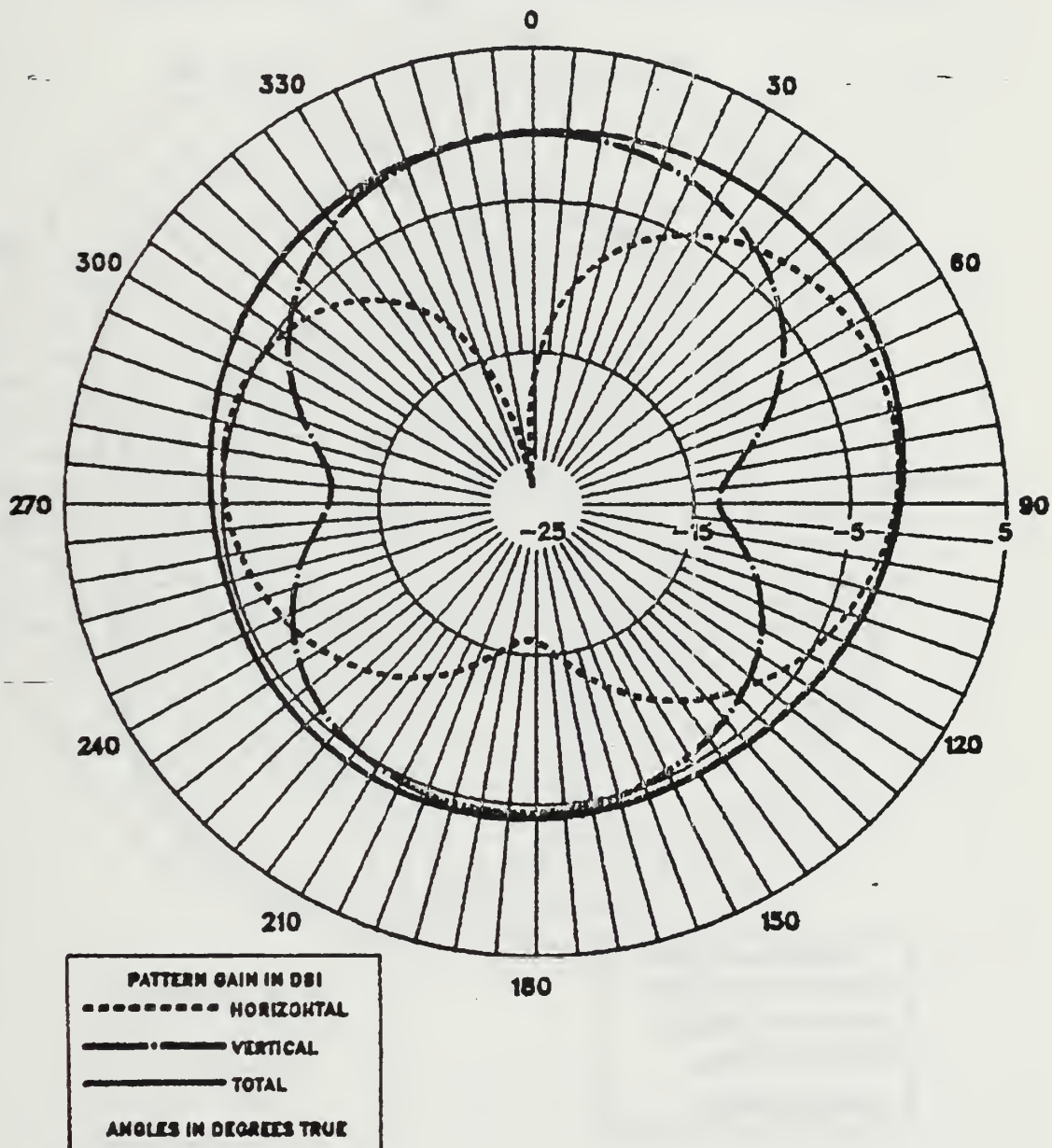
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COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



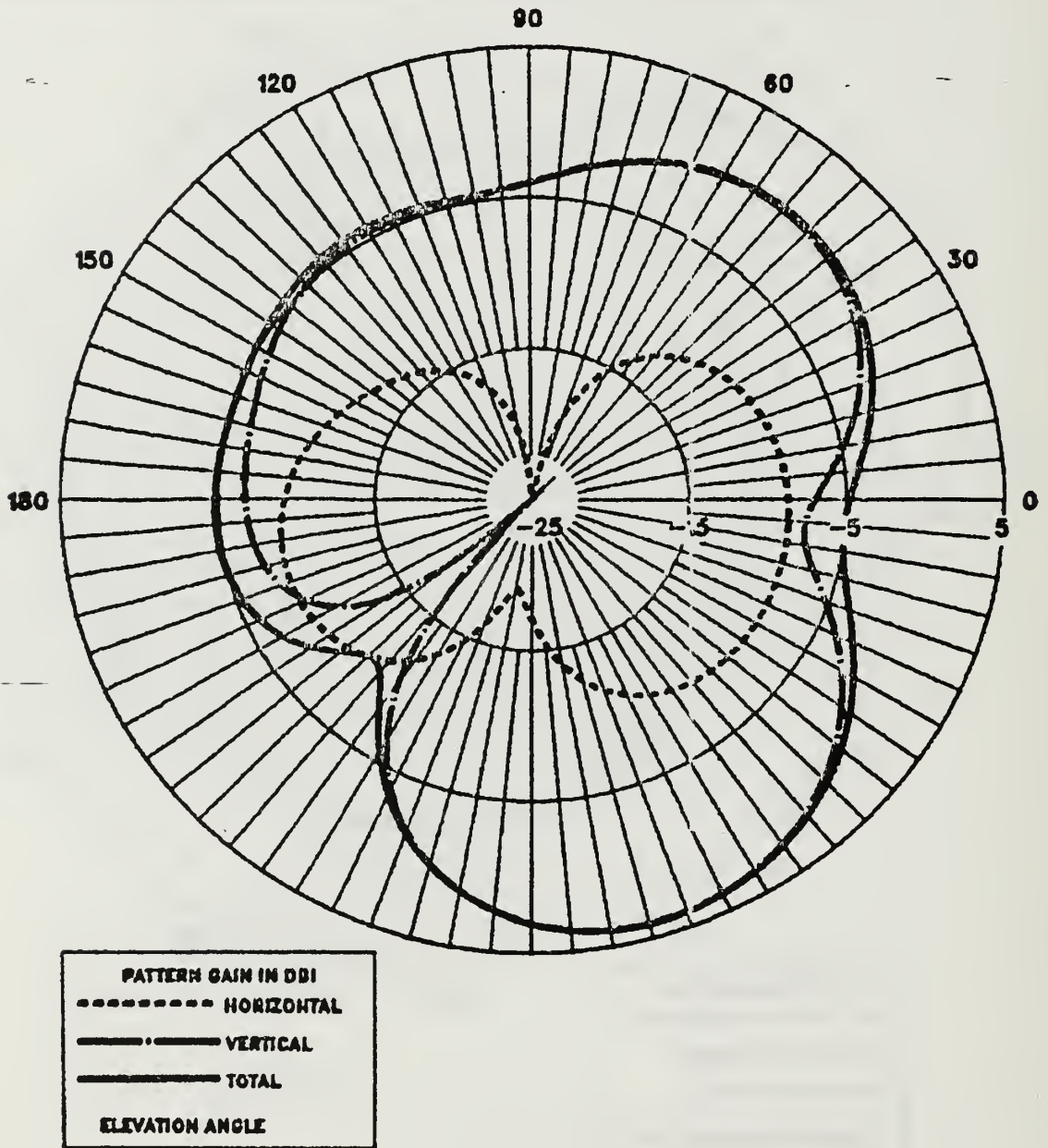
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COLLINS 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



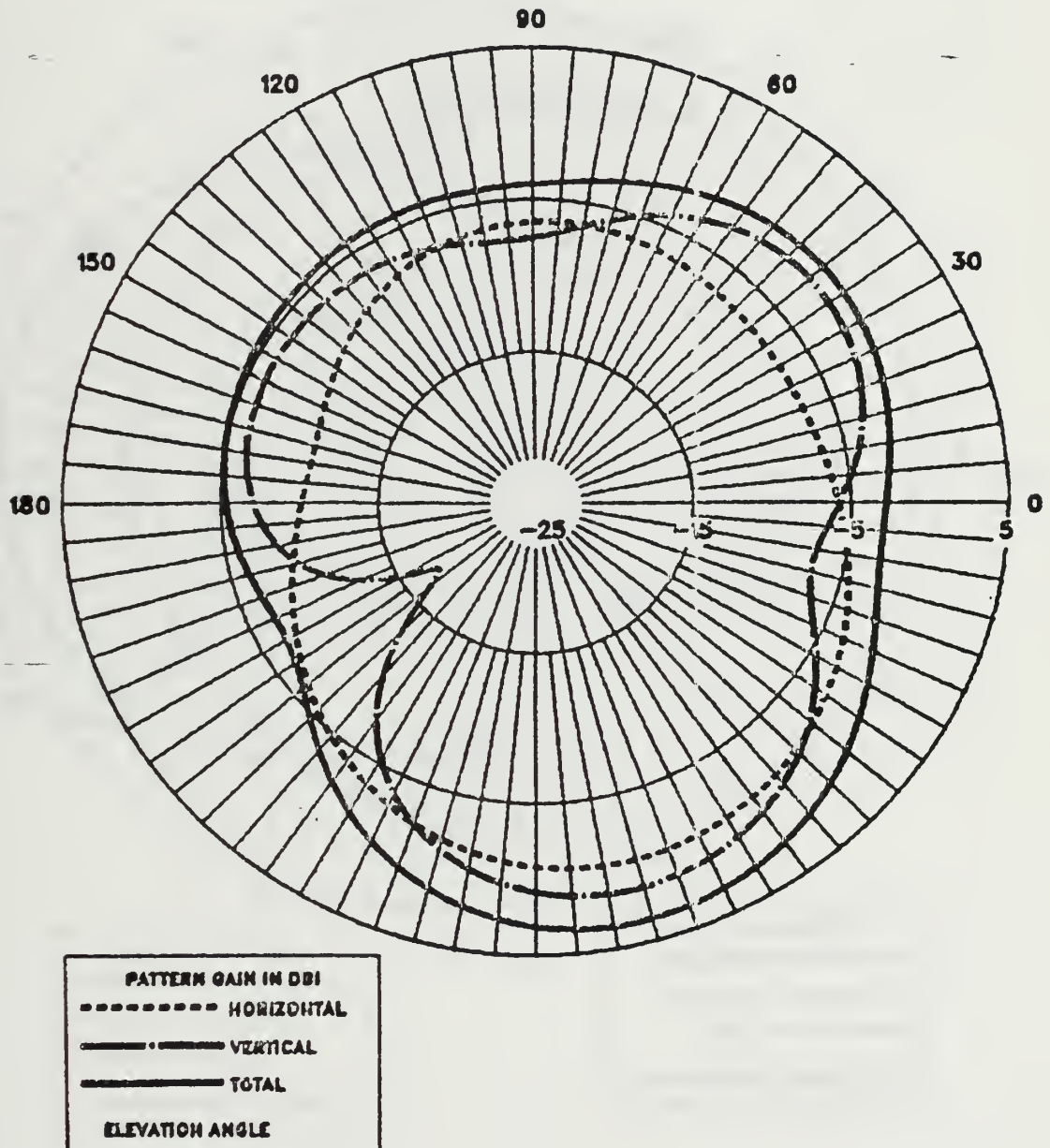
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COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



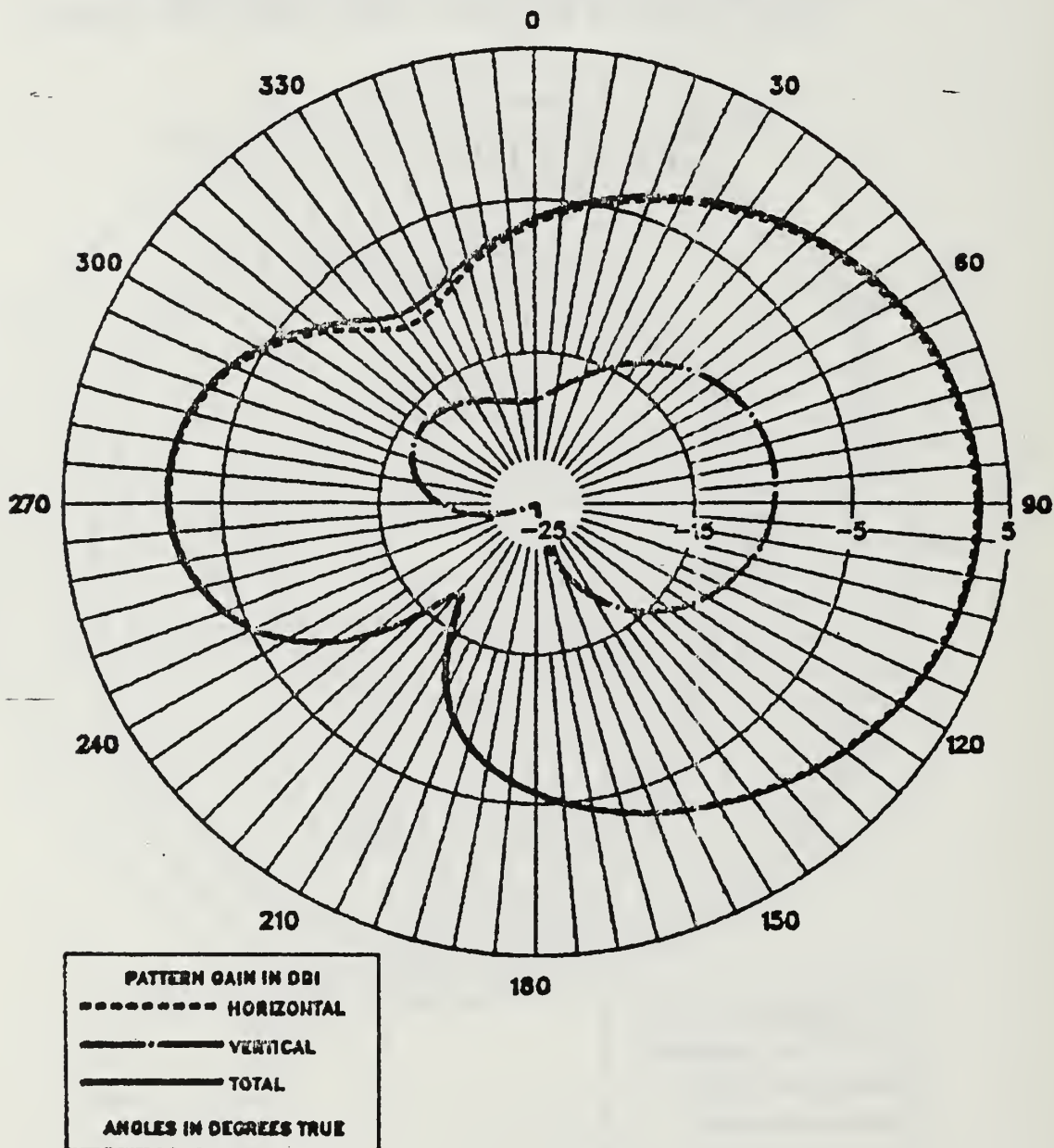
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COLLINS 437R-2 ANT, FREE SPACE, VERT CUT, $\Phi=45$



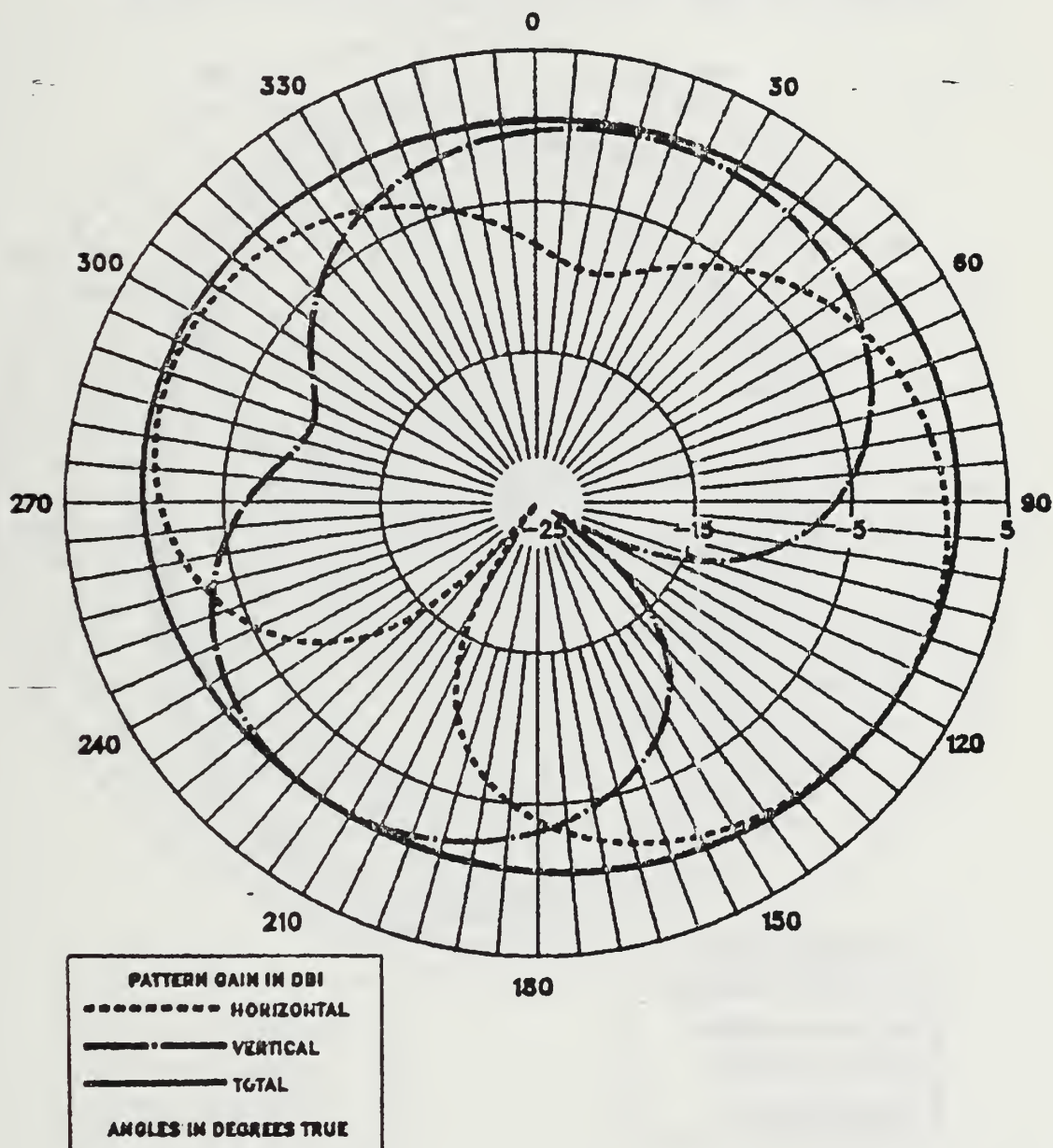
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



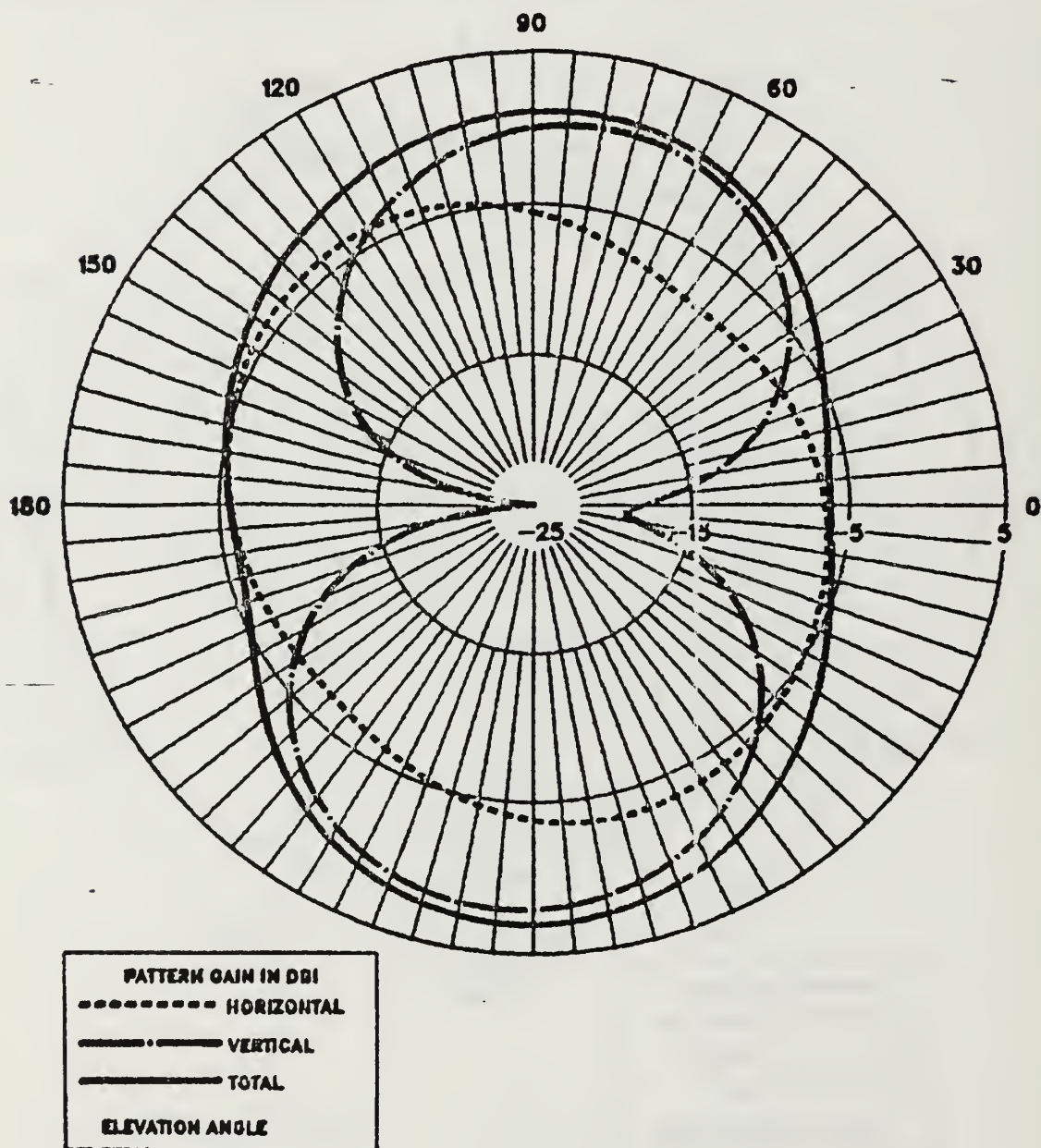
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



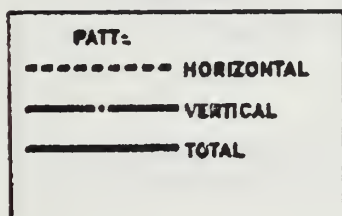
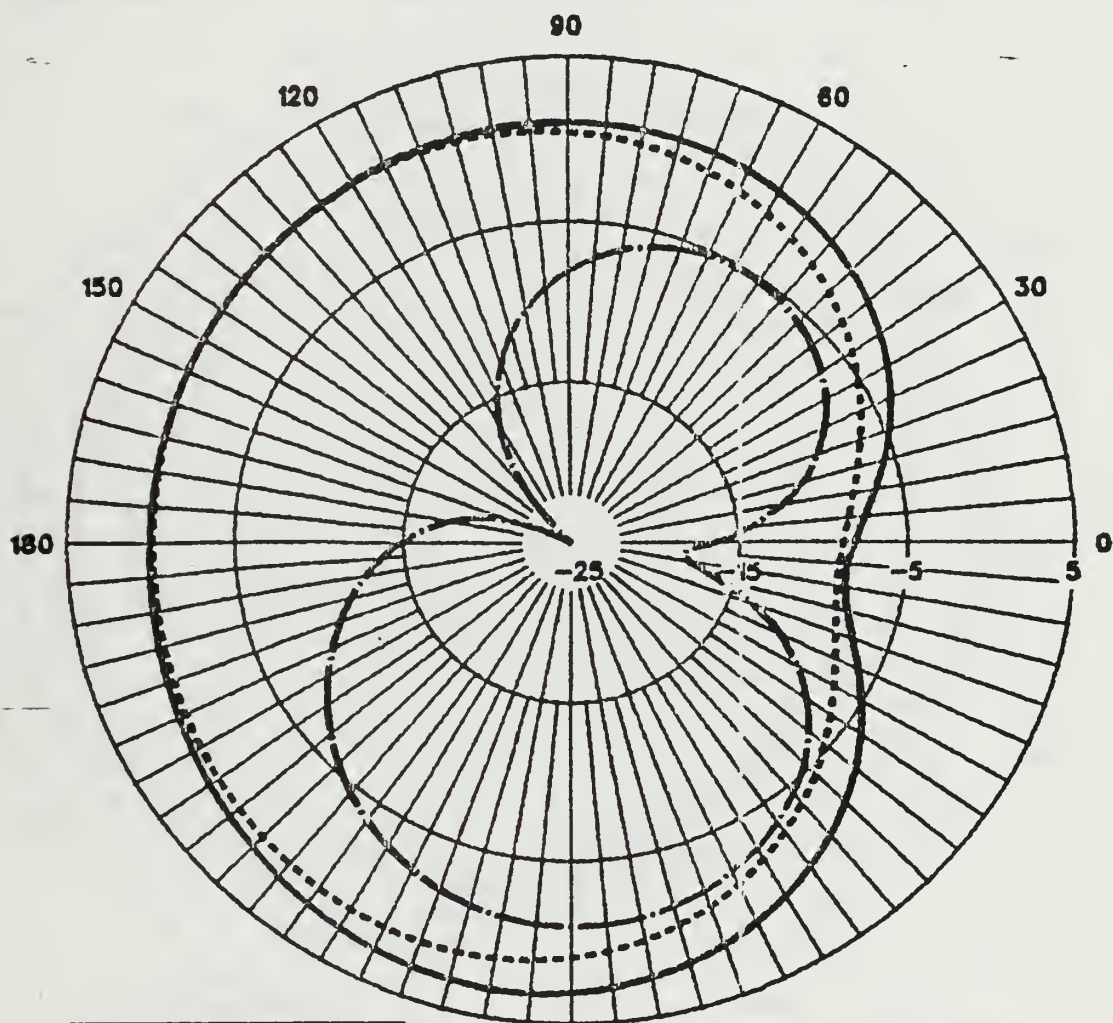
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



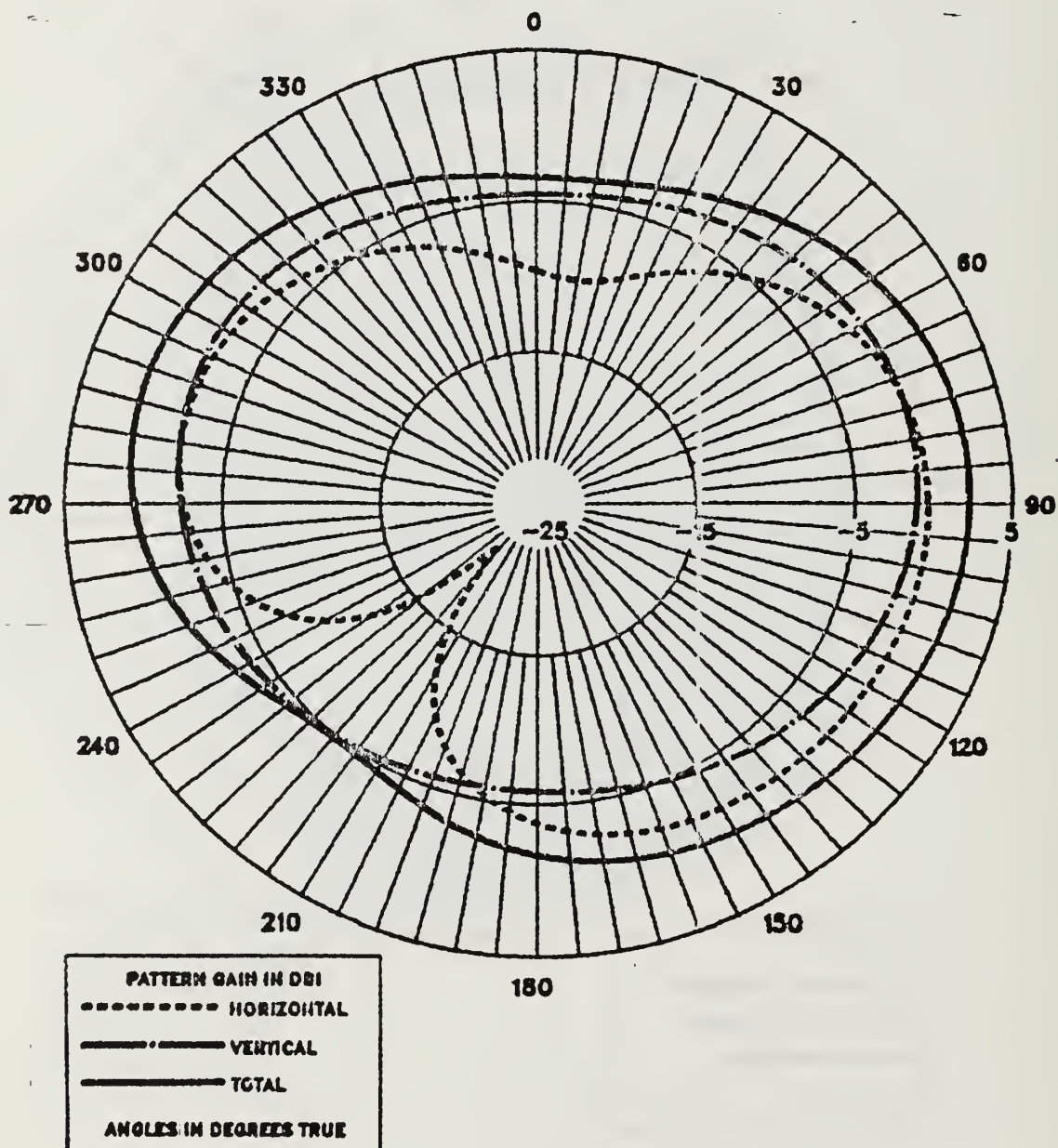
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, $\Phi=45$



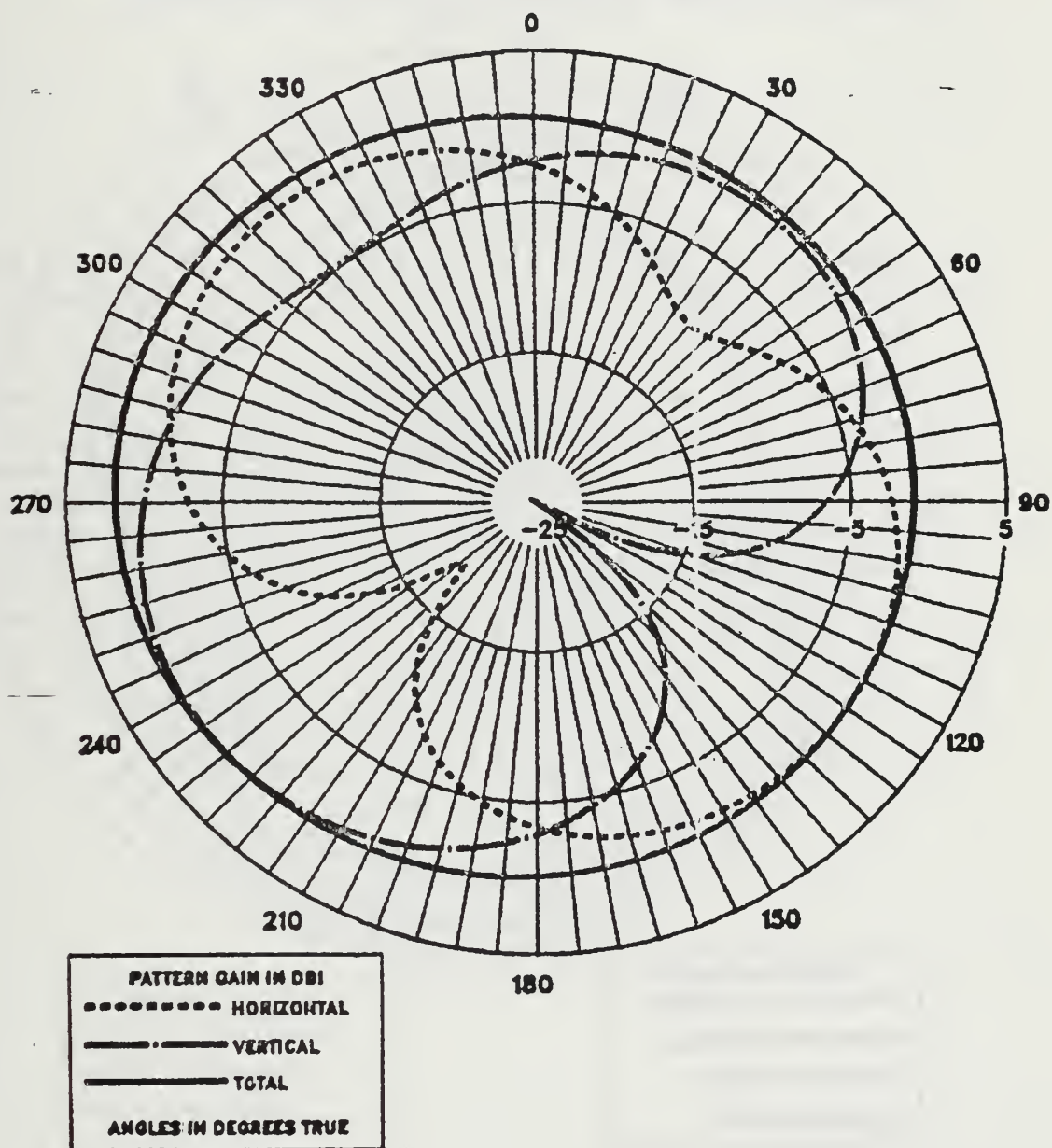
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LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=90



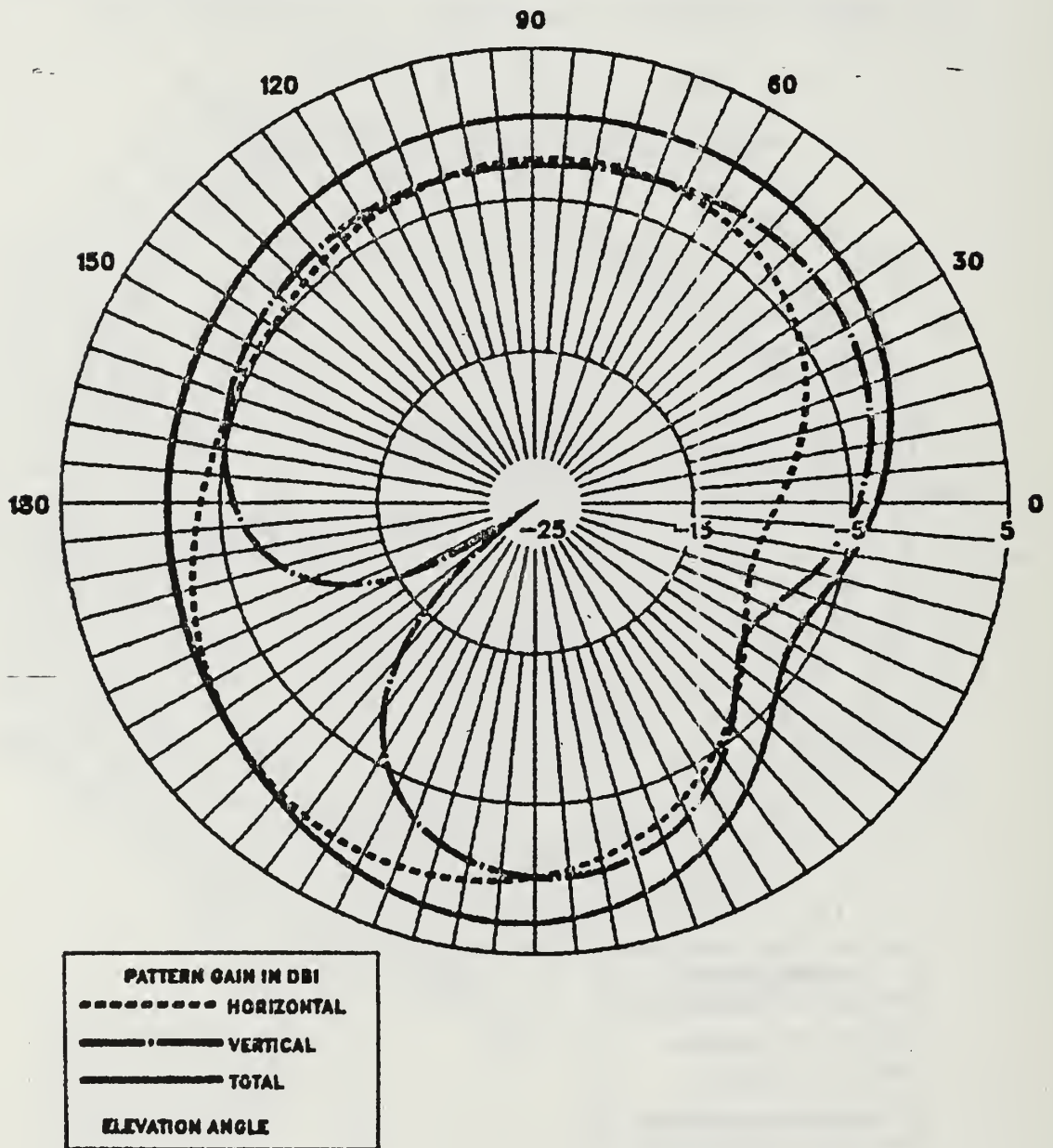
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LONG SHUNTED LOOP, FREE SPACE, HORIZ CUT, THETA=26



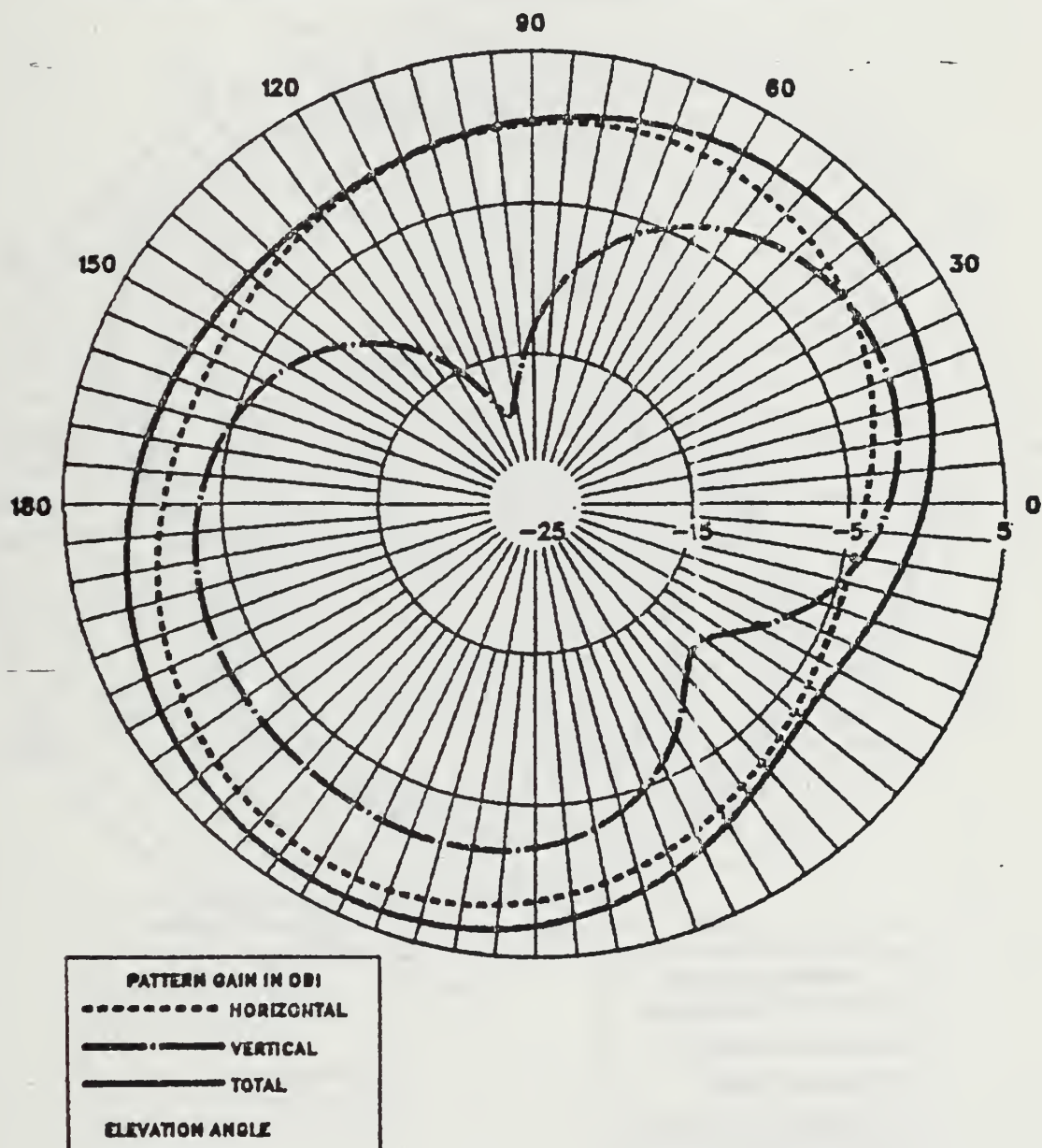
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LONG SHUNTED LOOP, FREE SPACE, VERT CUT, PHI=0



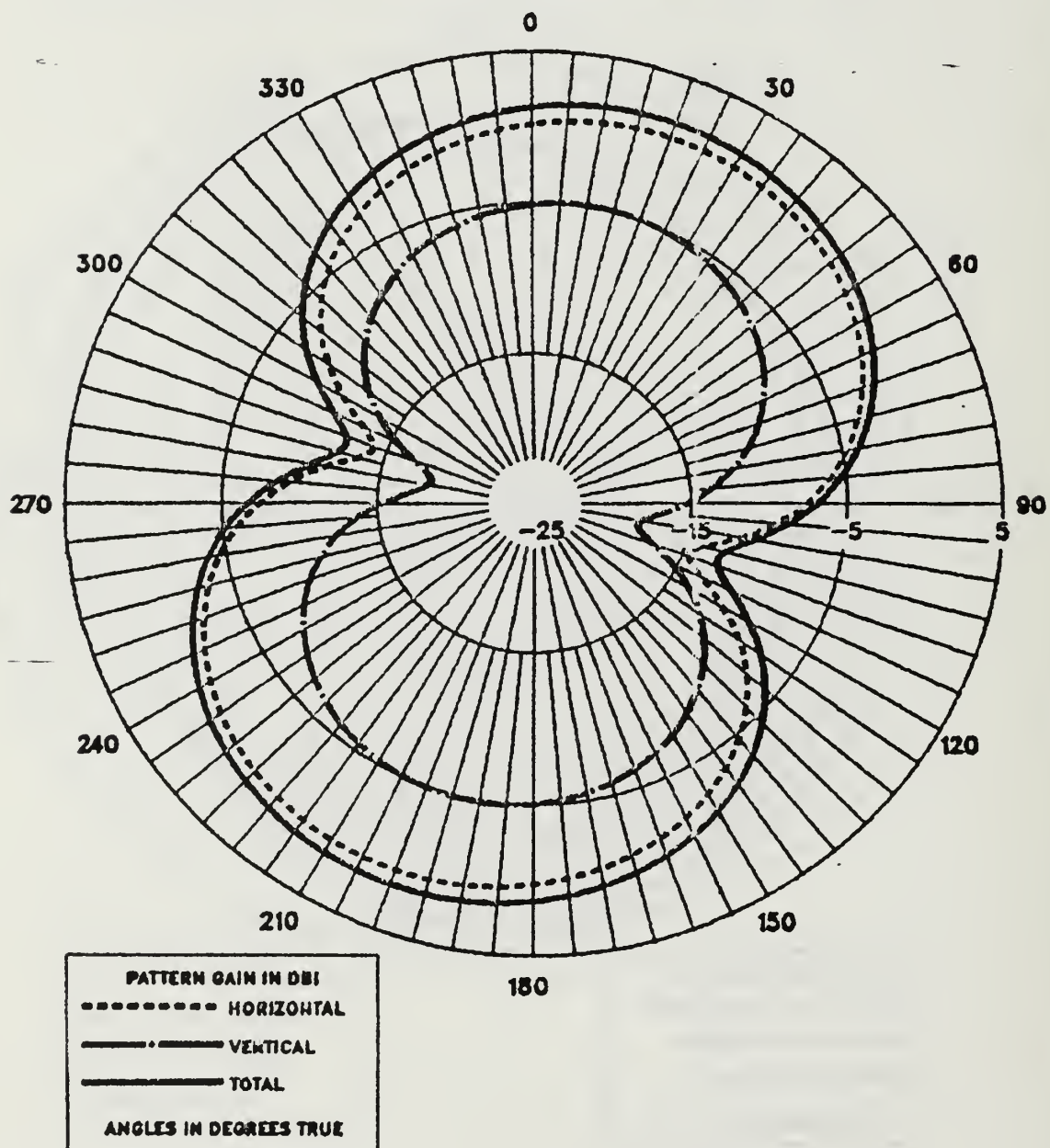
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LONG SHUNTED LOOP, FREE SPACE, VERT CUT, $\Phi=45$



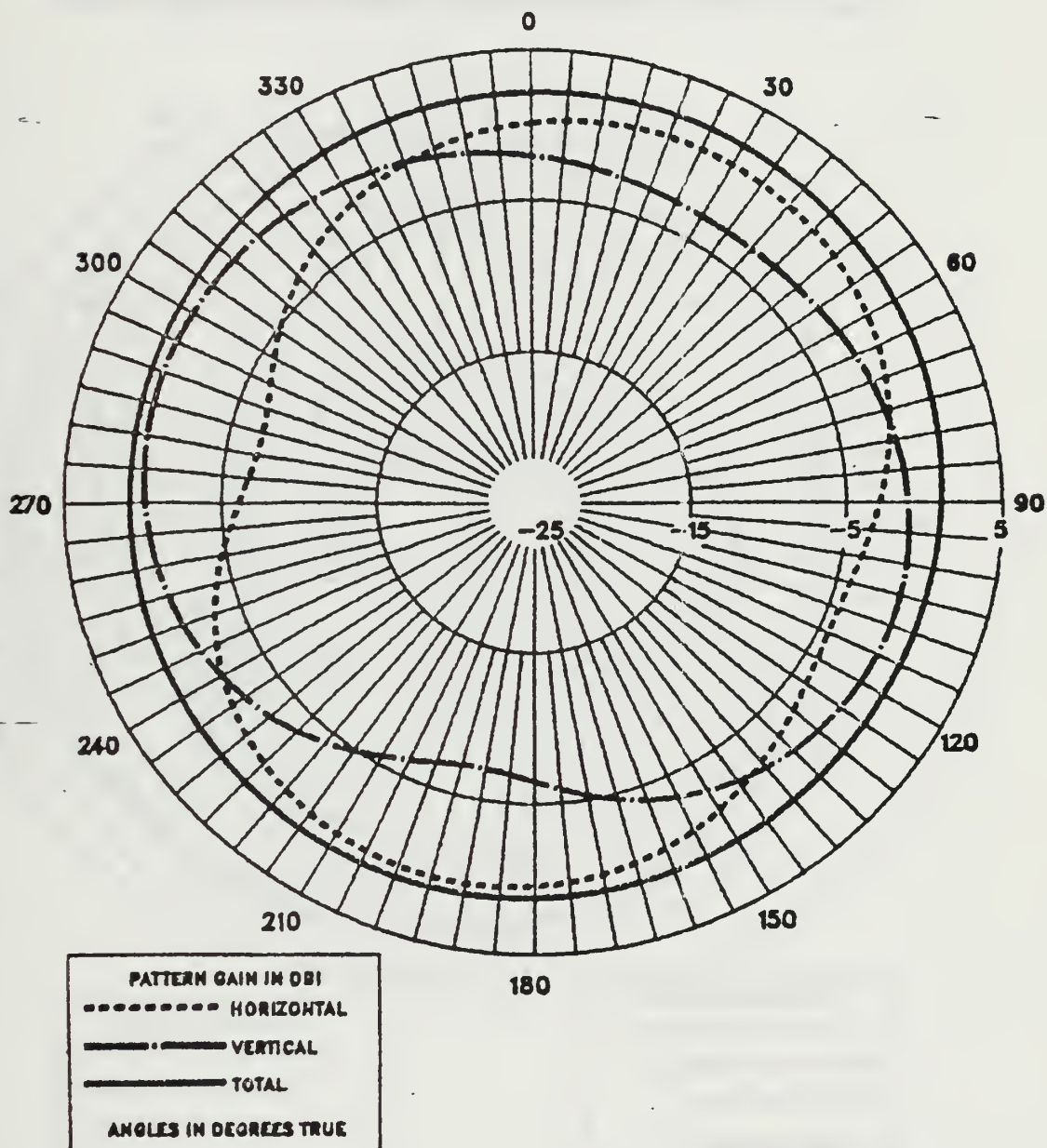
H60 IGUANA DATA RUN AT 3.123MHZ ON 8/19/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



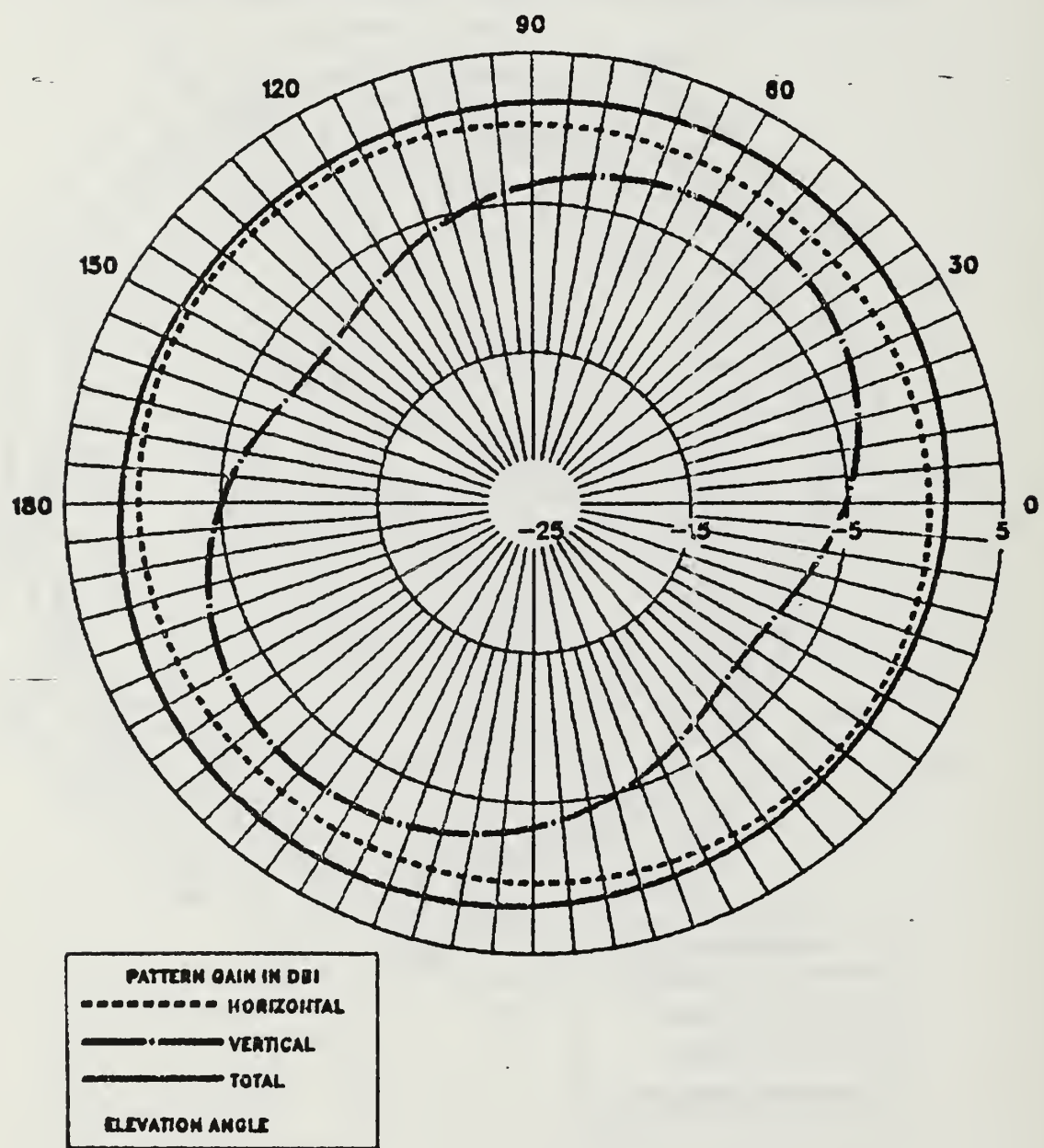
H60 IGUANA DATA RUN AT 3.123MHZ ON 8/19/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



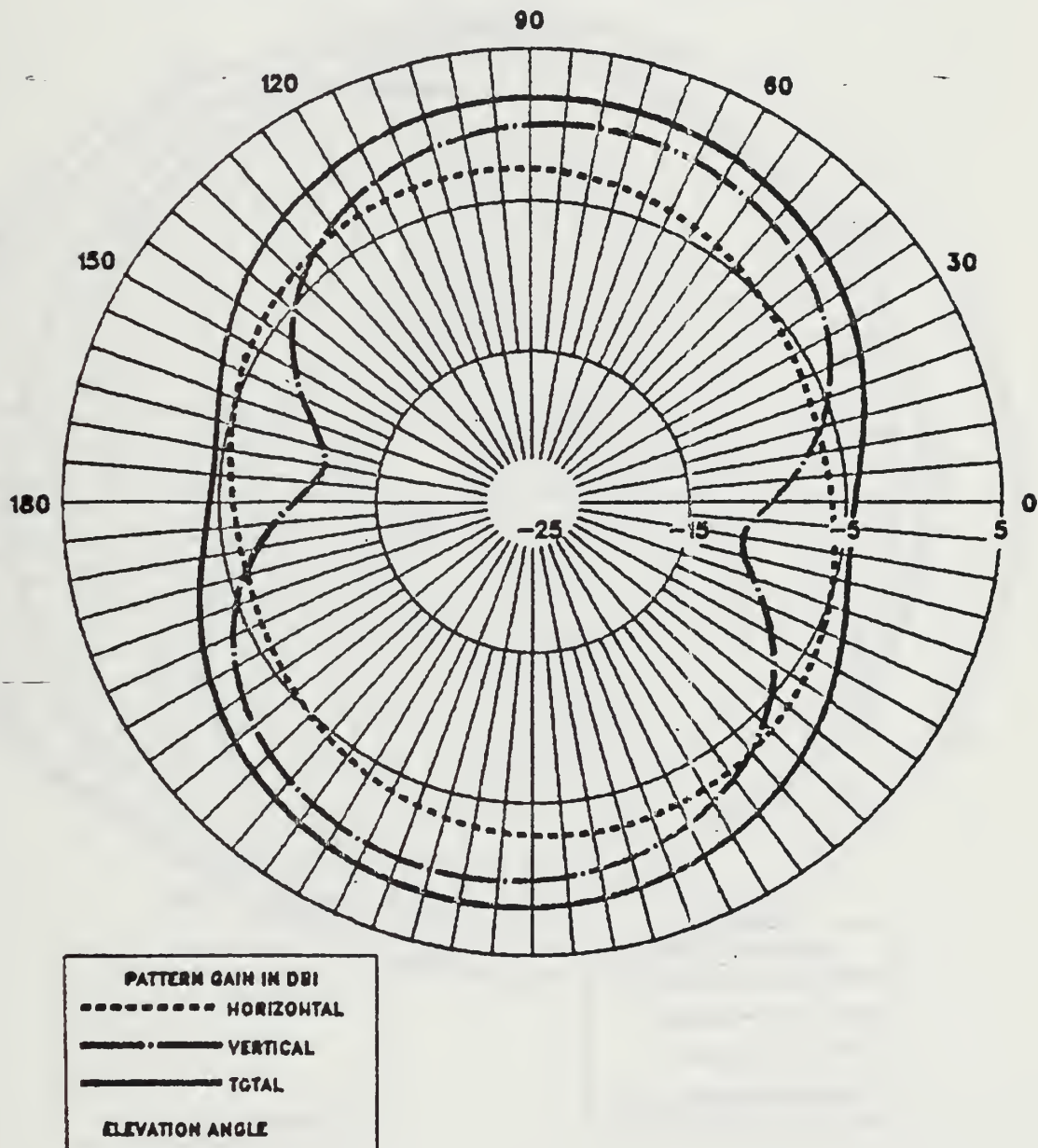
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



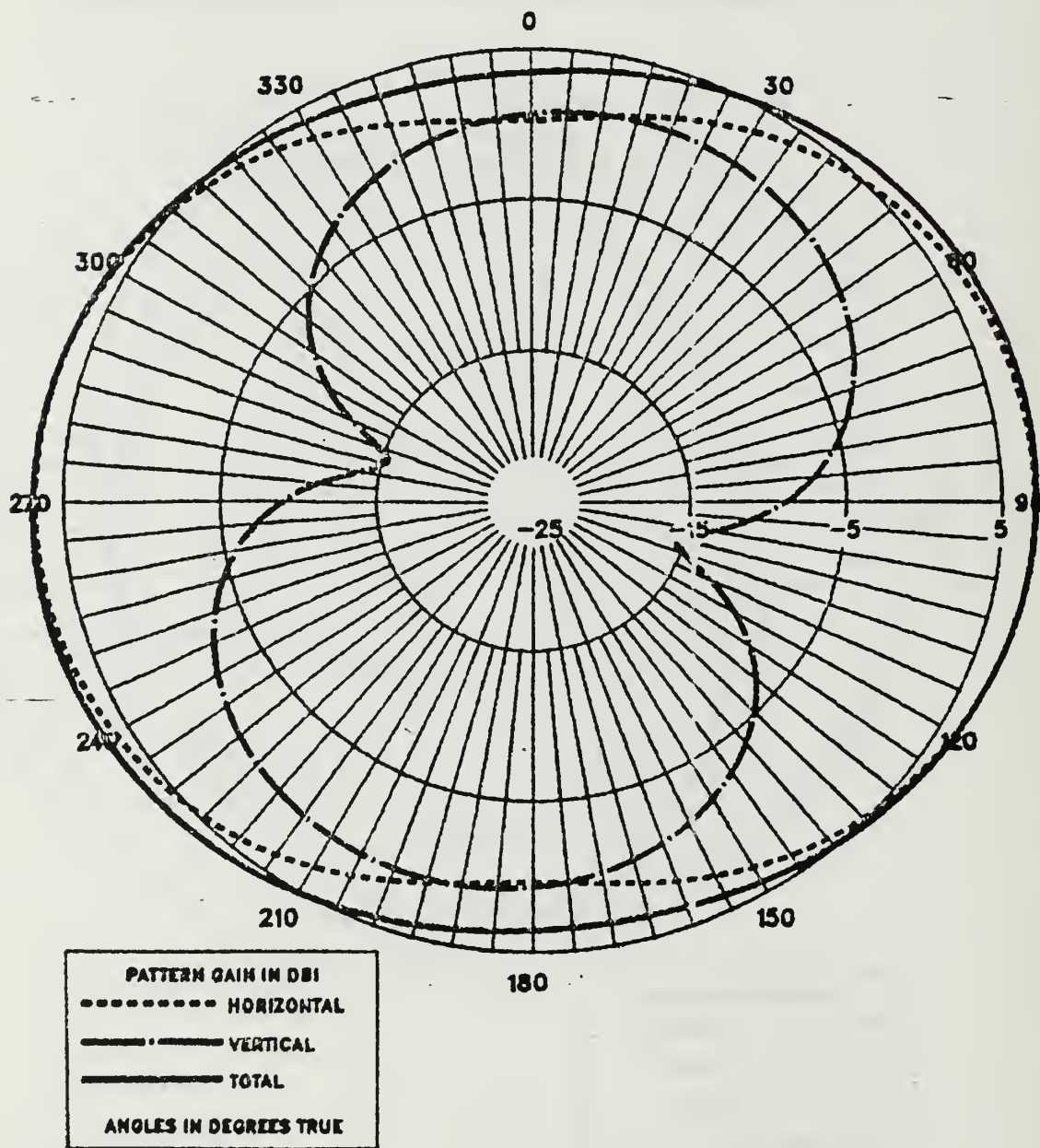
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



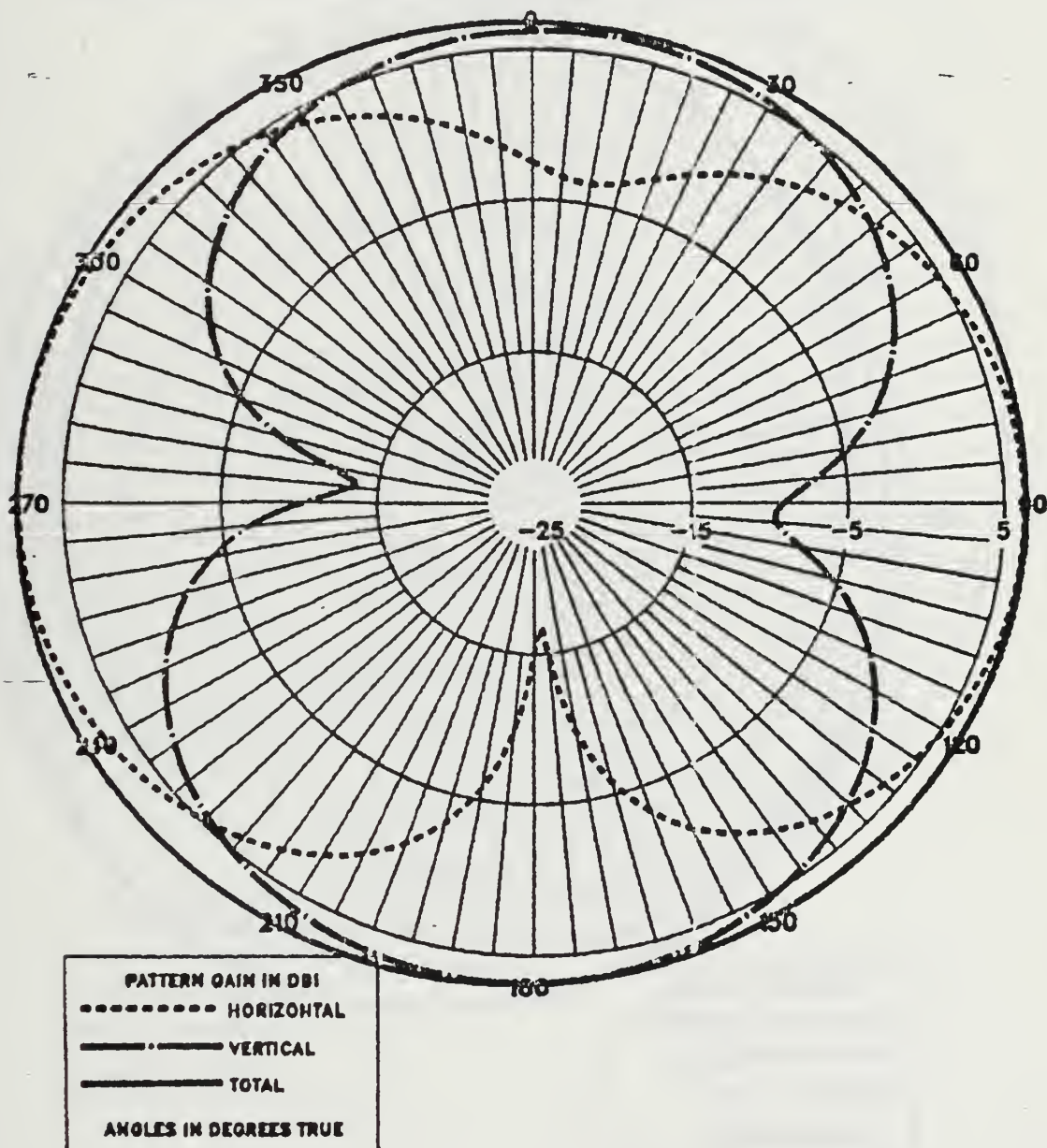
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NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



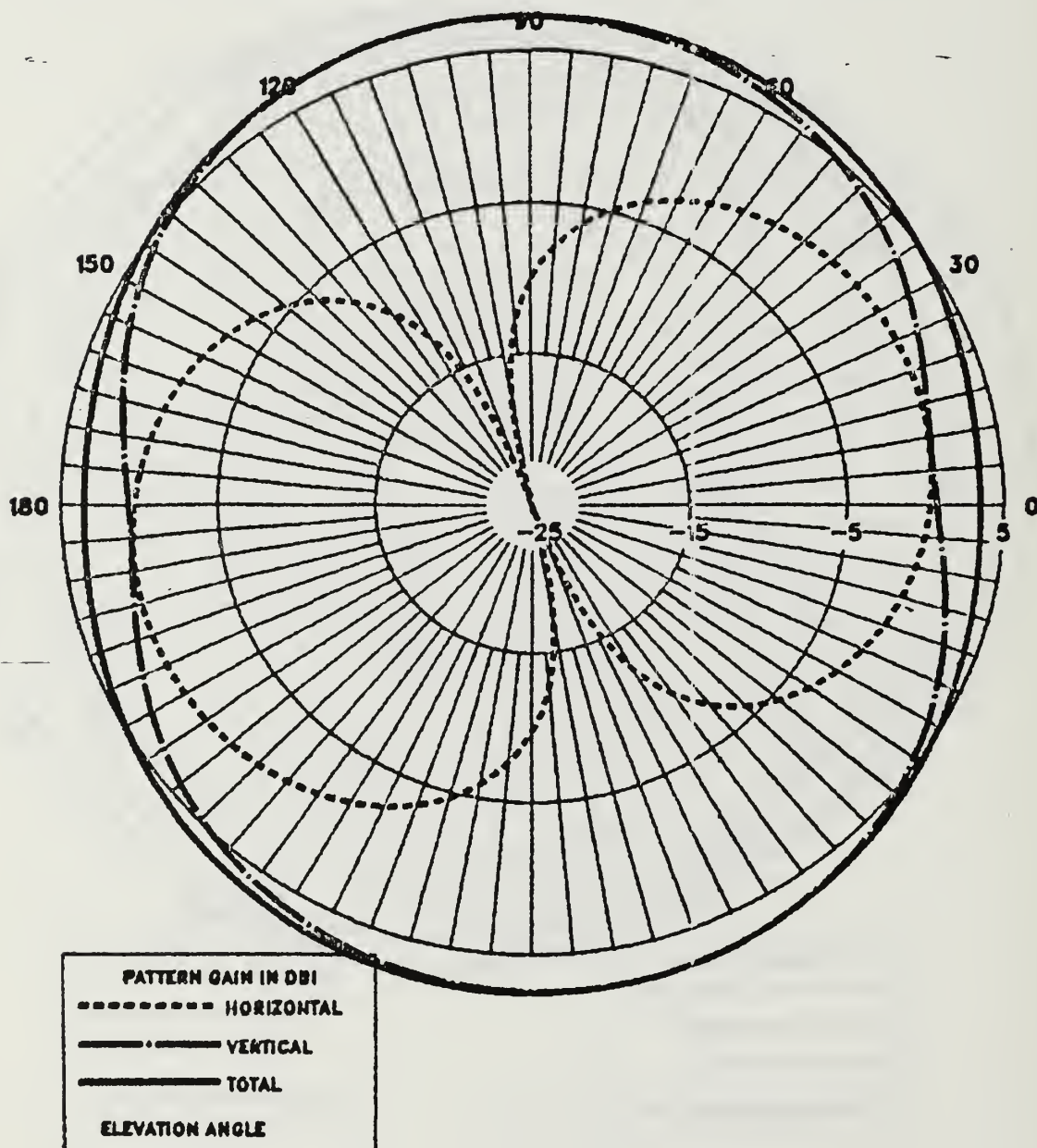
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NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



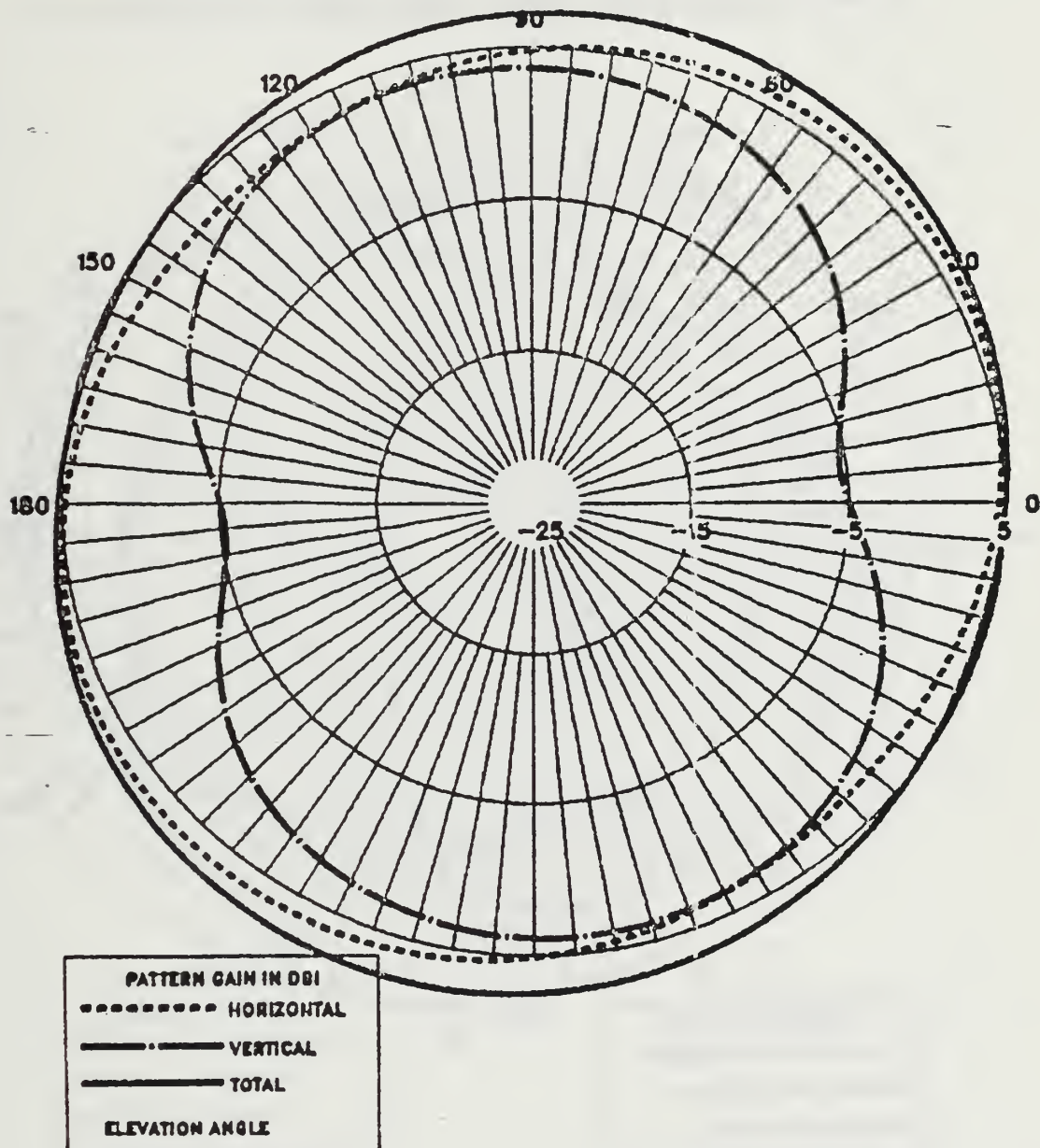
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NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



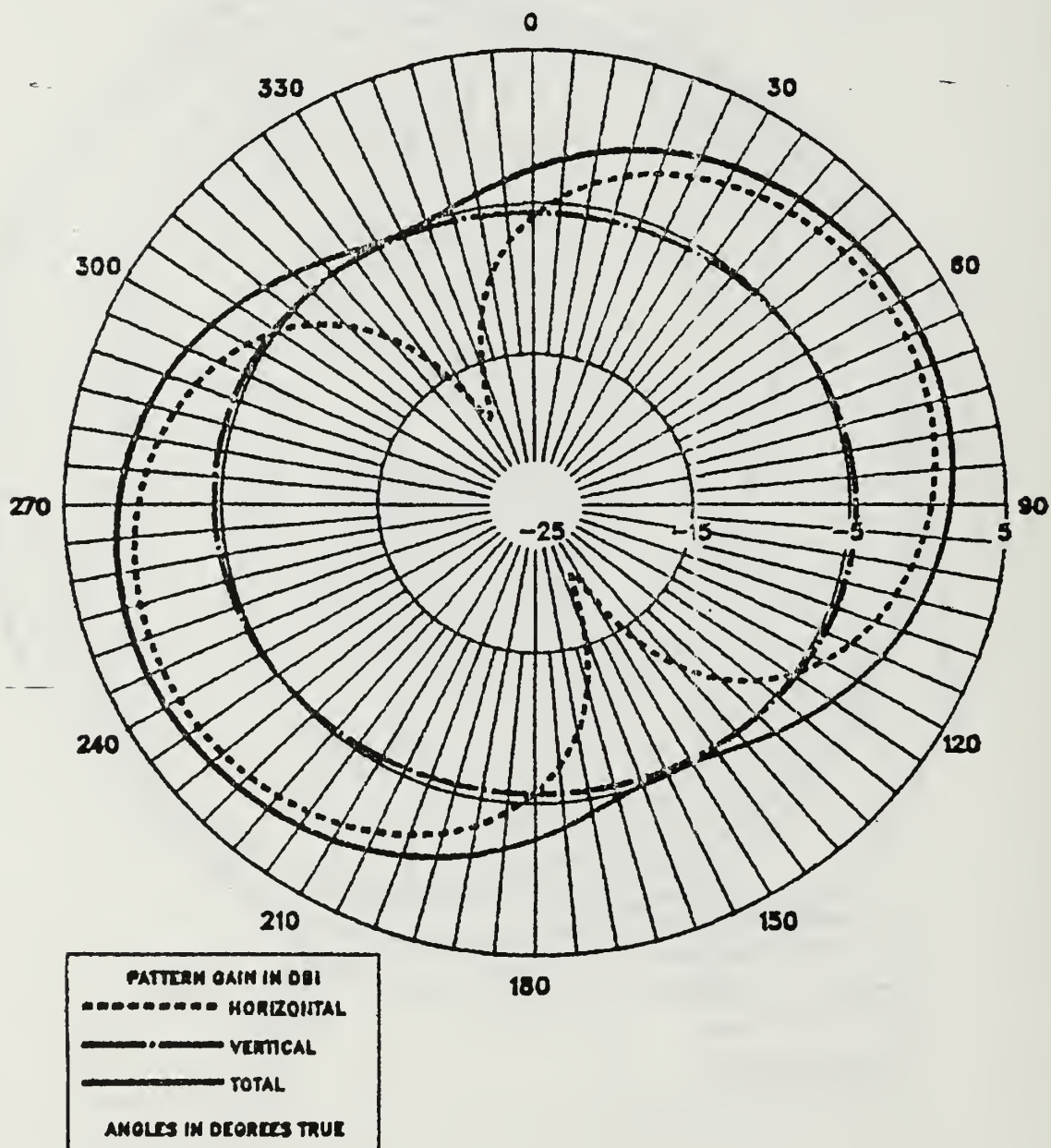
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NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



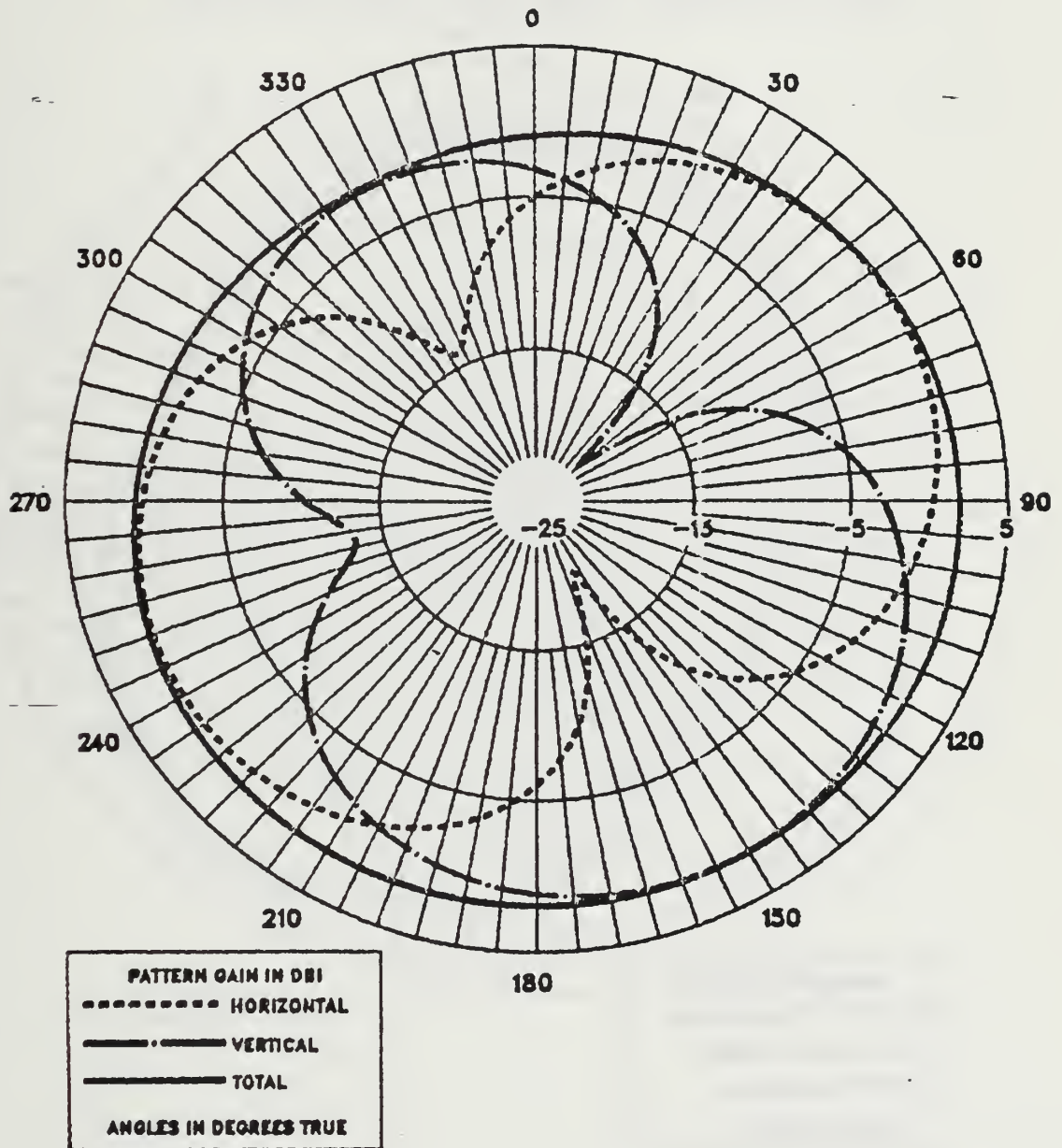
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



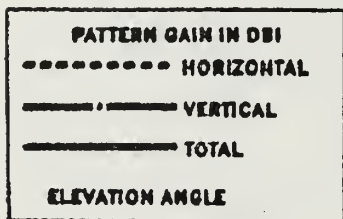
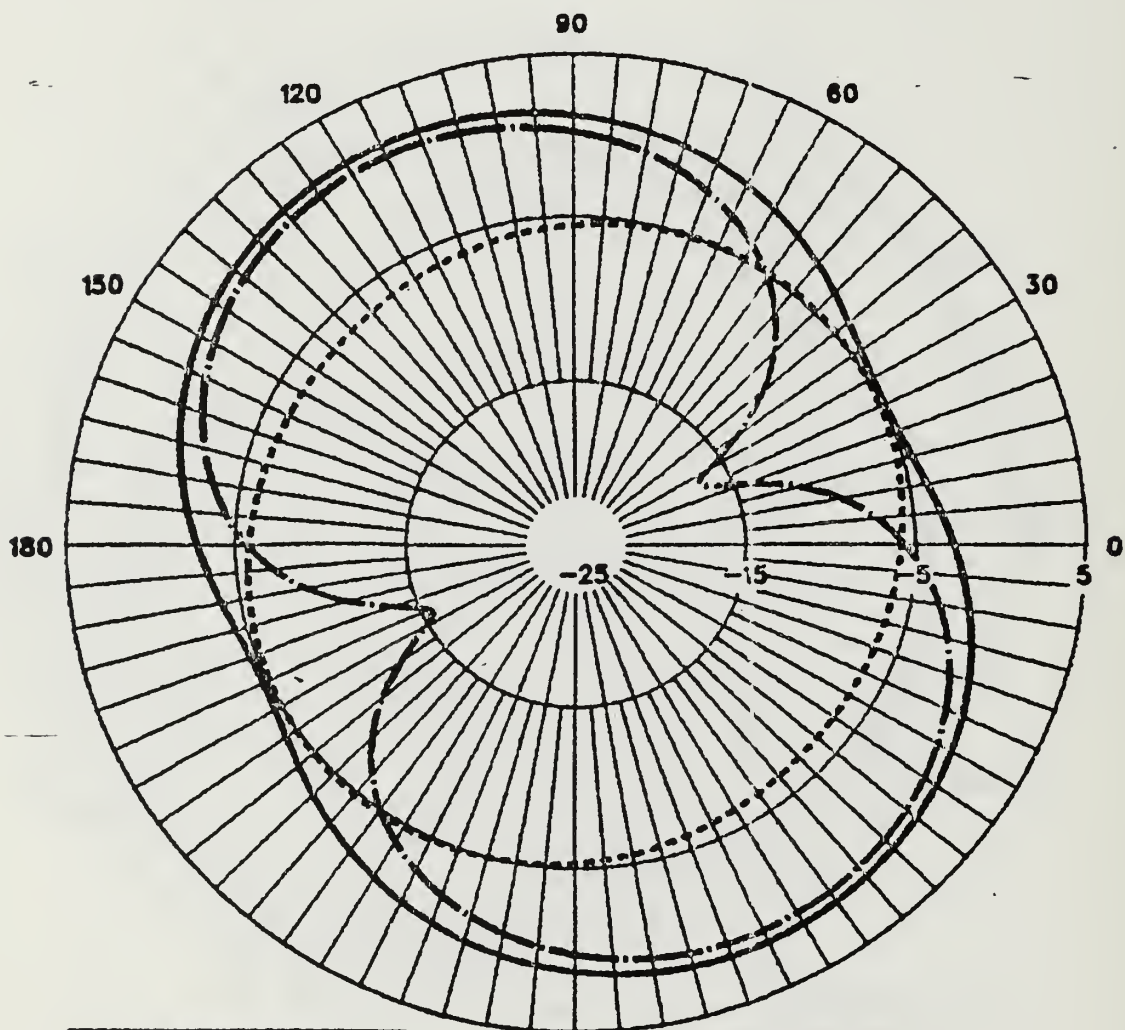
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



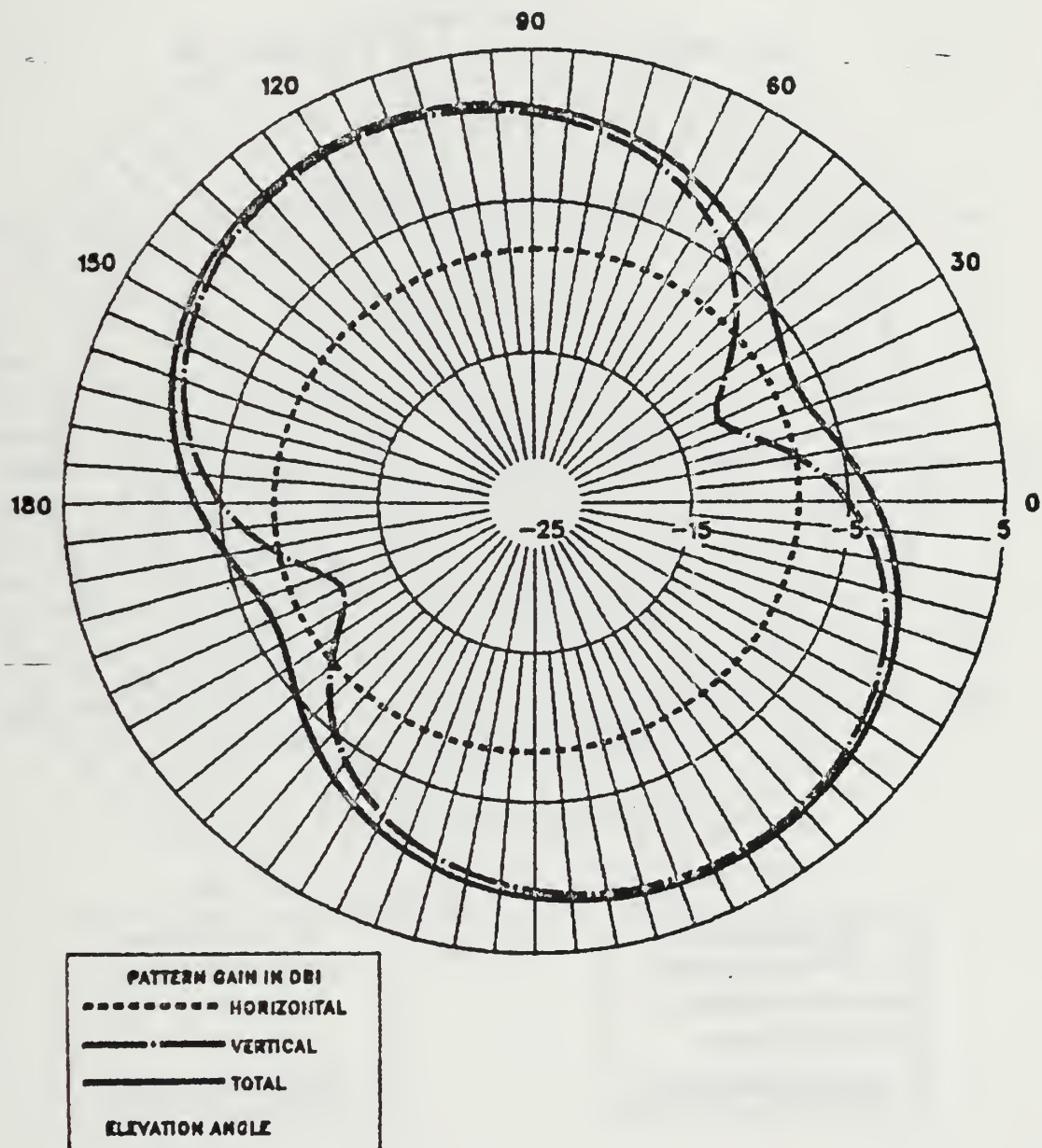
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



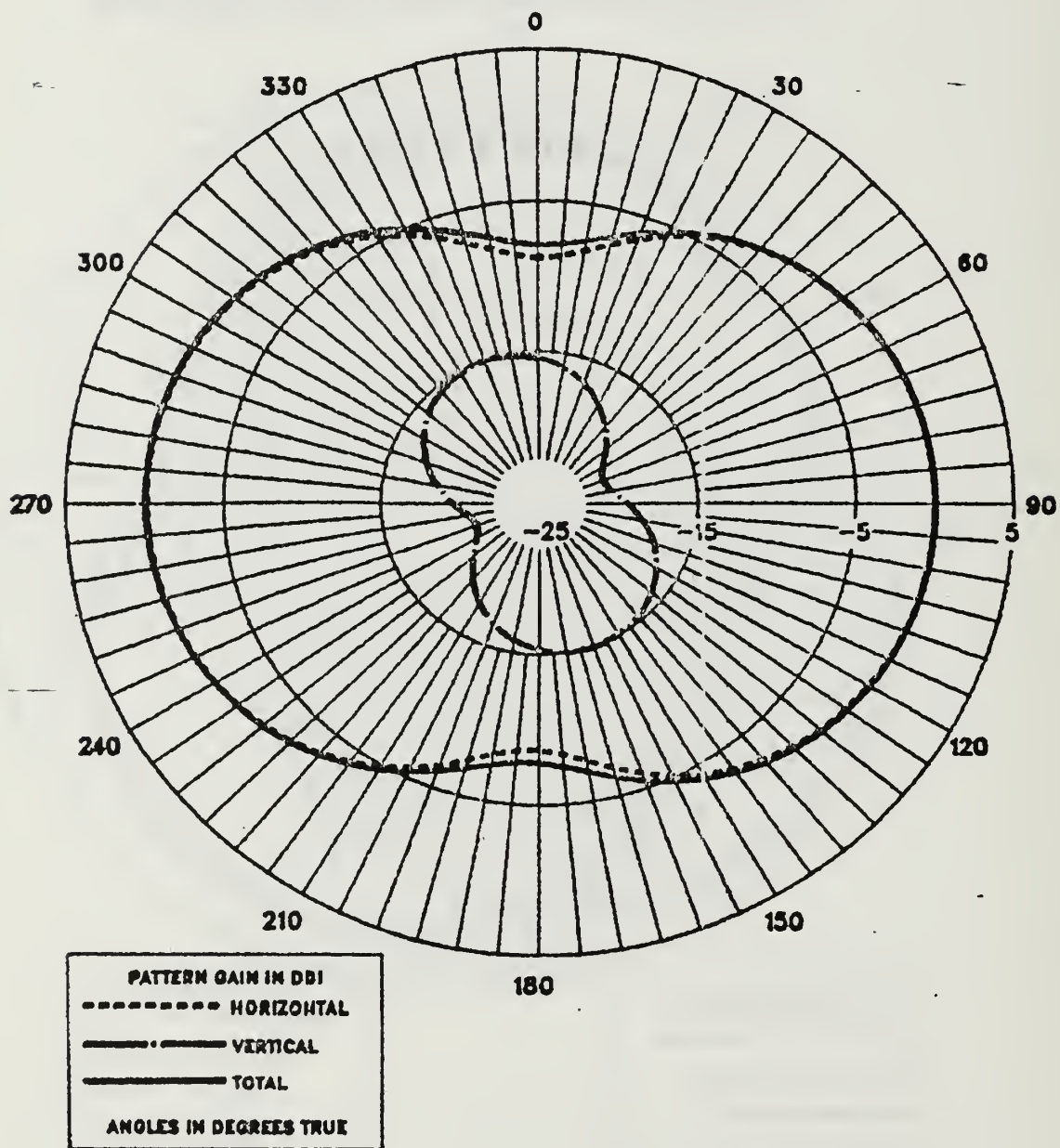
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



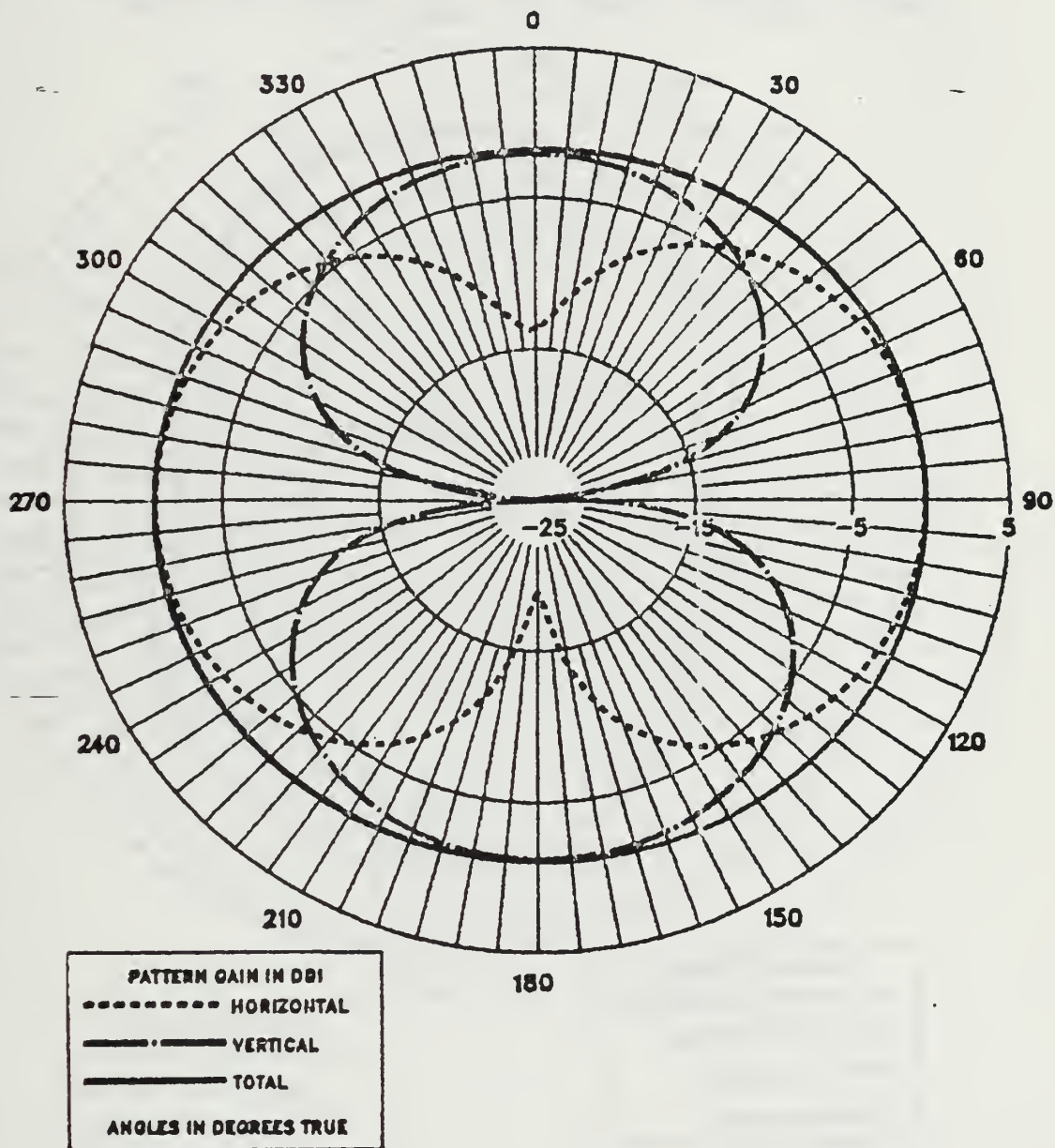
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CTU, THETA=90



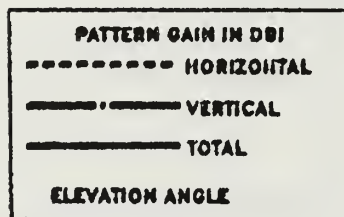
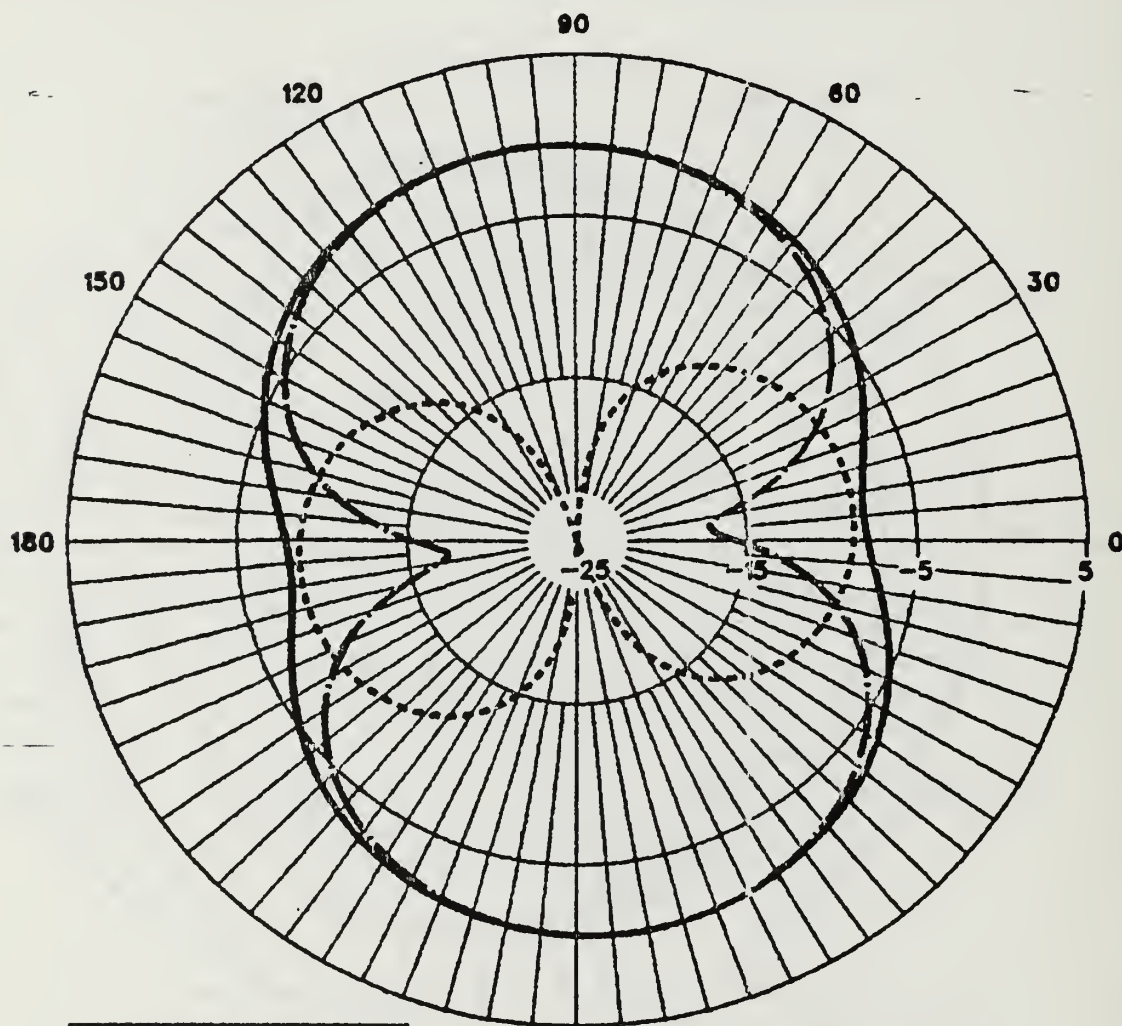
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



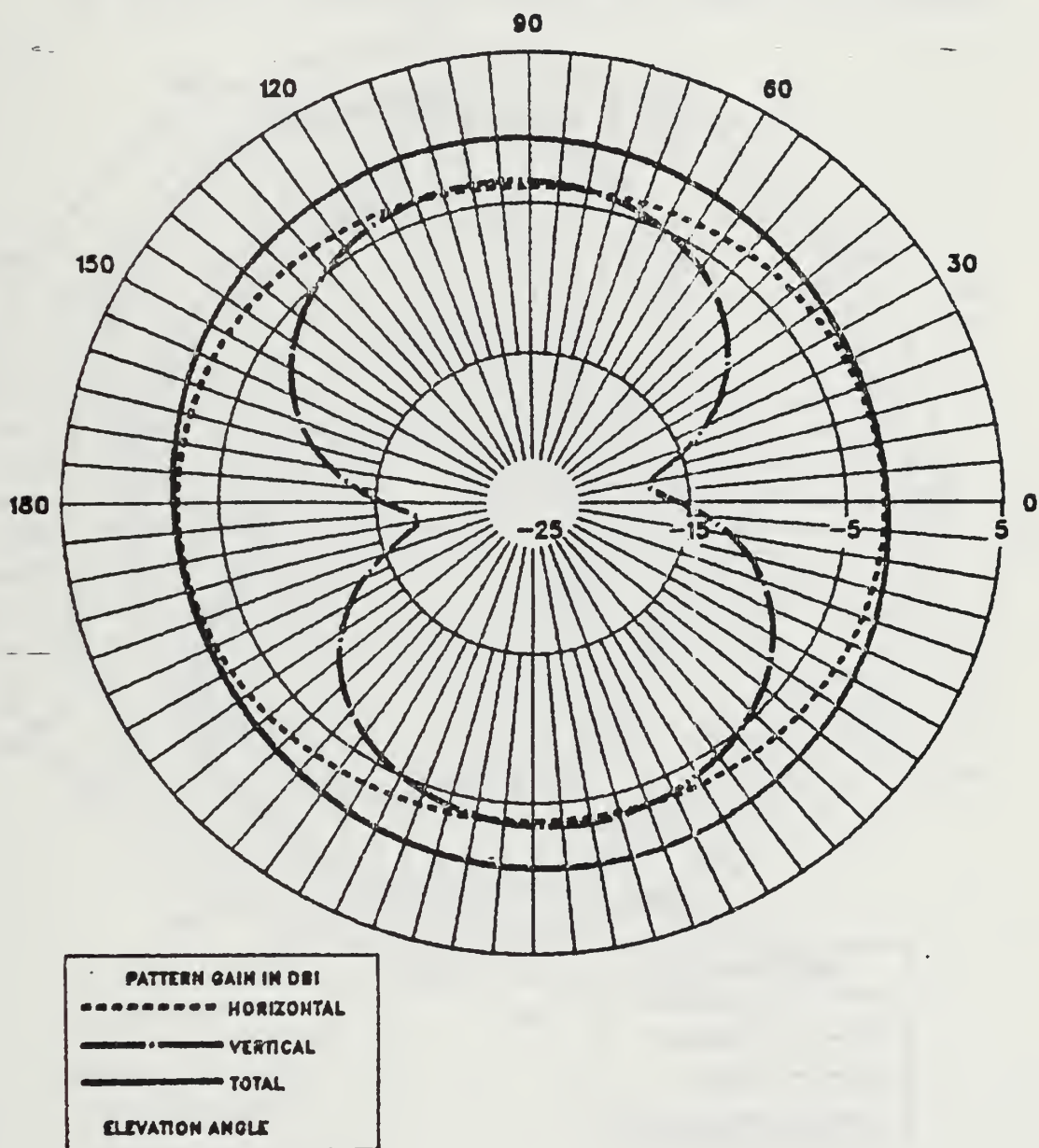
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ARMY--TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



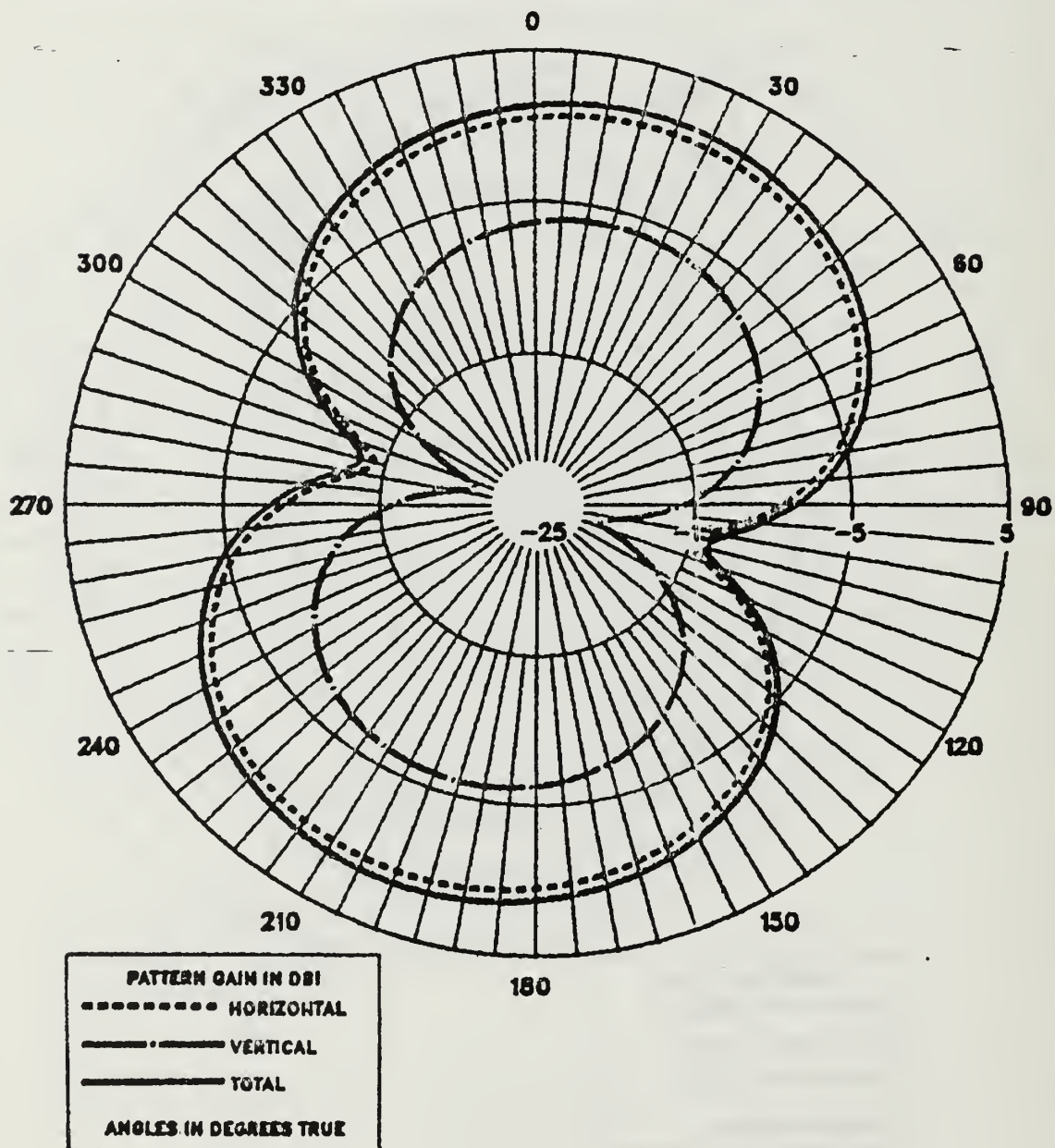
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, $\Phi=45$



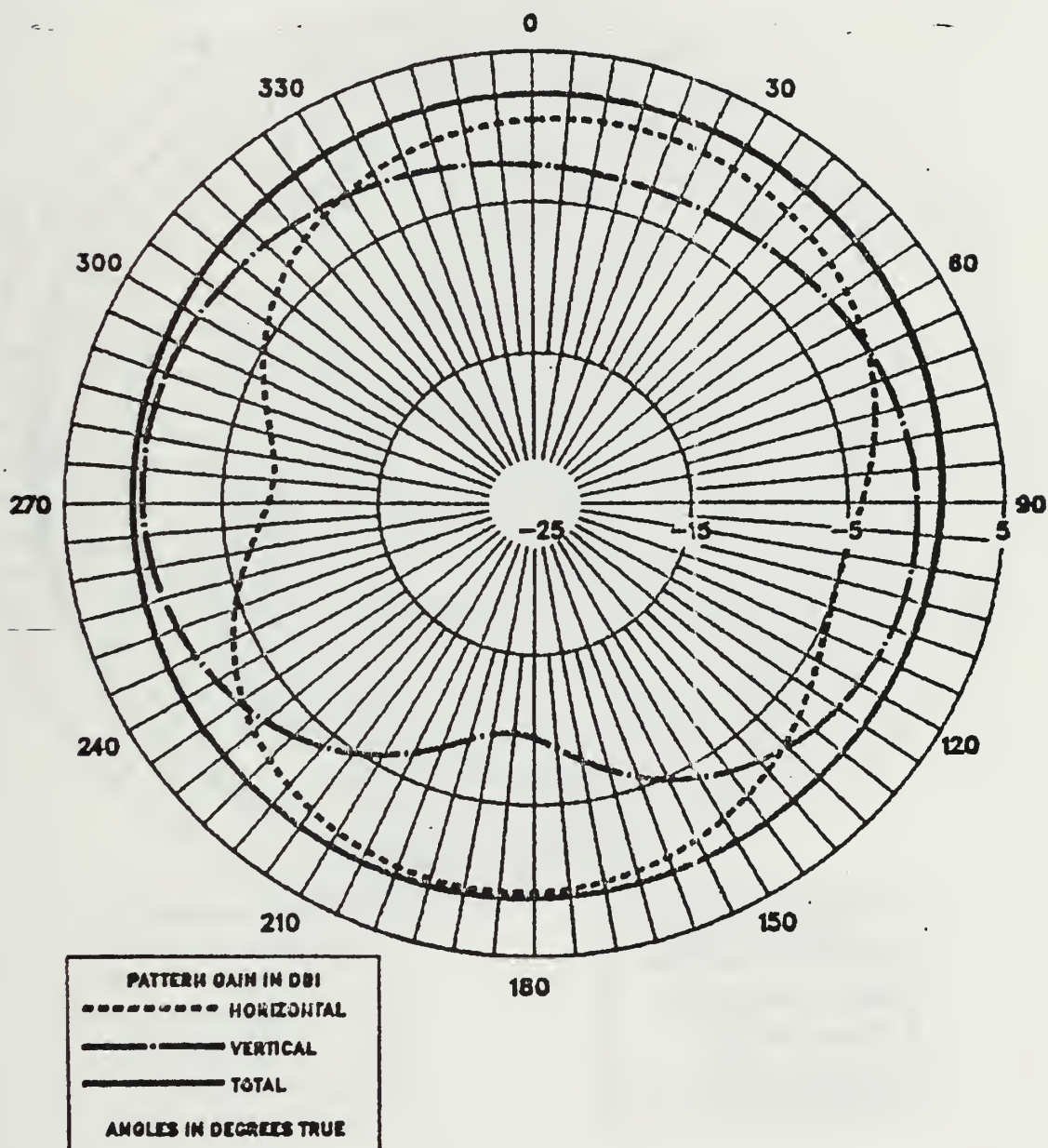
H60 IGUANA DATA RUN AT 4.040MHZ ON 8/18/87

LW SPACED 18" FROM A/C, FREE SPACE, HORIZ CUT, THETA=90



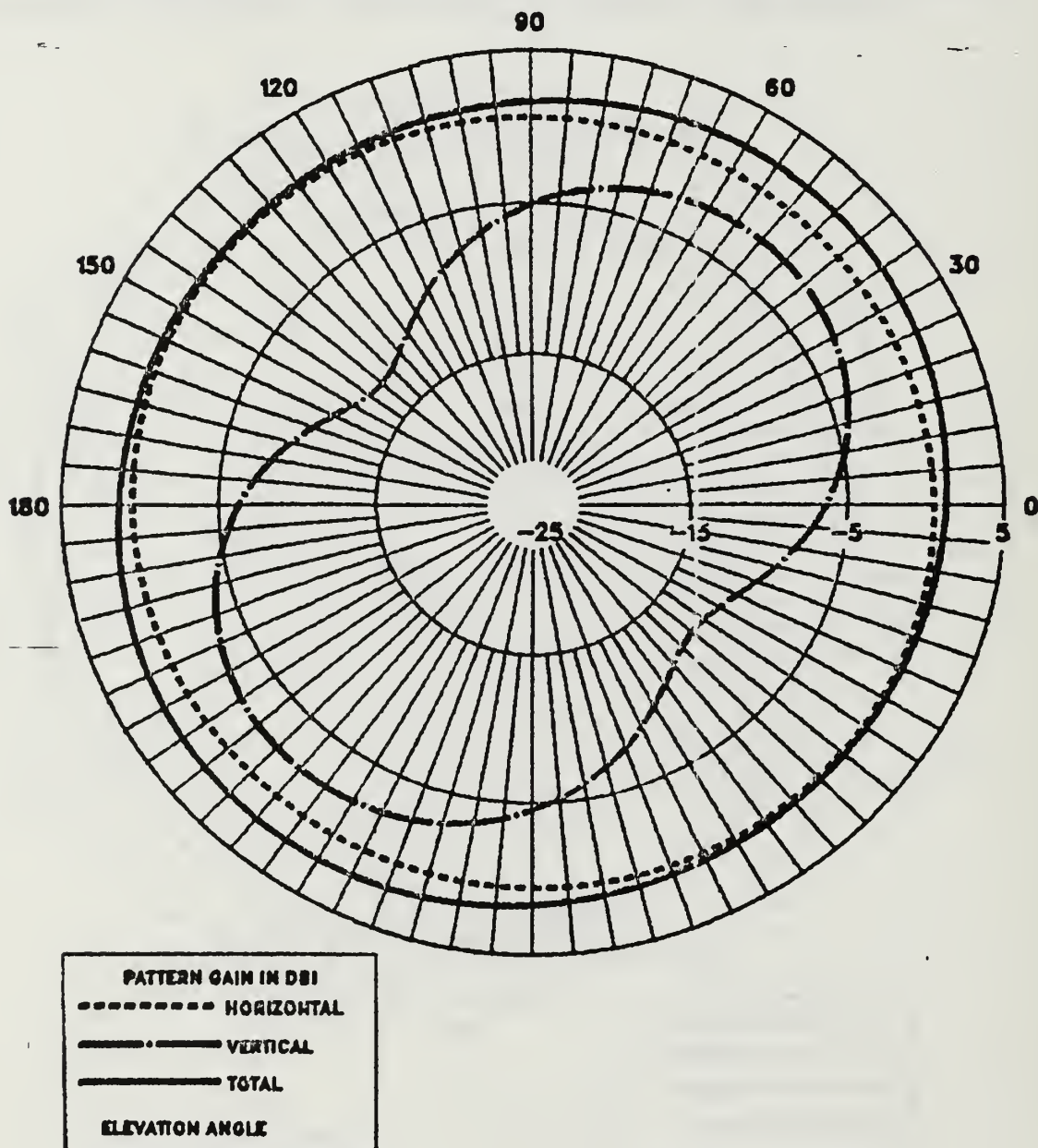
H60 IGUANA DATA RUN AT 4.040MHZ ON 8/18/87

LW SPACED 18" FROM A/C, FREE SPACE, HORIZ CUT, THETA=26



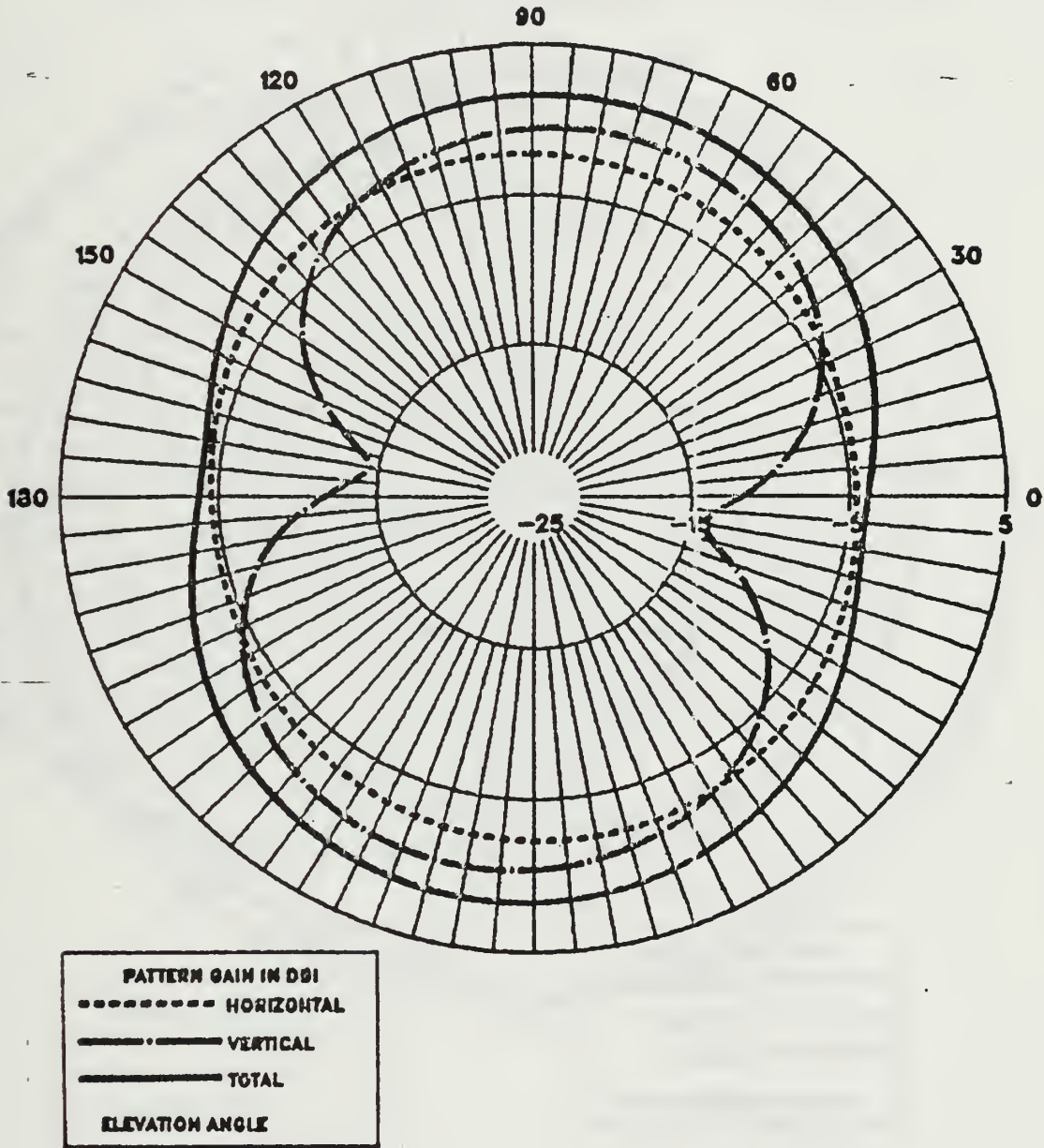
H60 IGUANA DATA RUN AT 4.040MHZ ON 8/18/87

LW SPACED 18" FROM A/C, FREE SPACE, VERT CUT, PHI=0



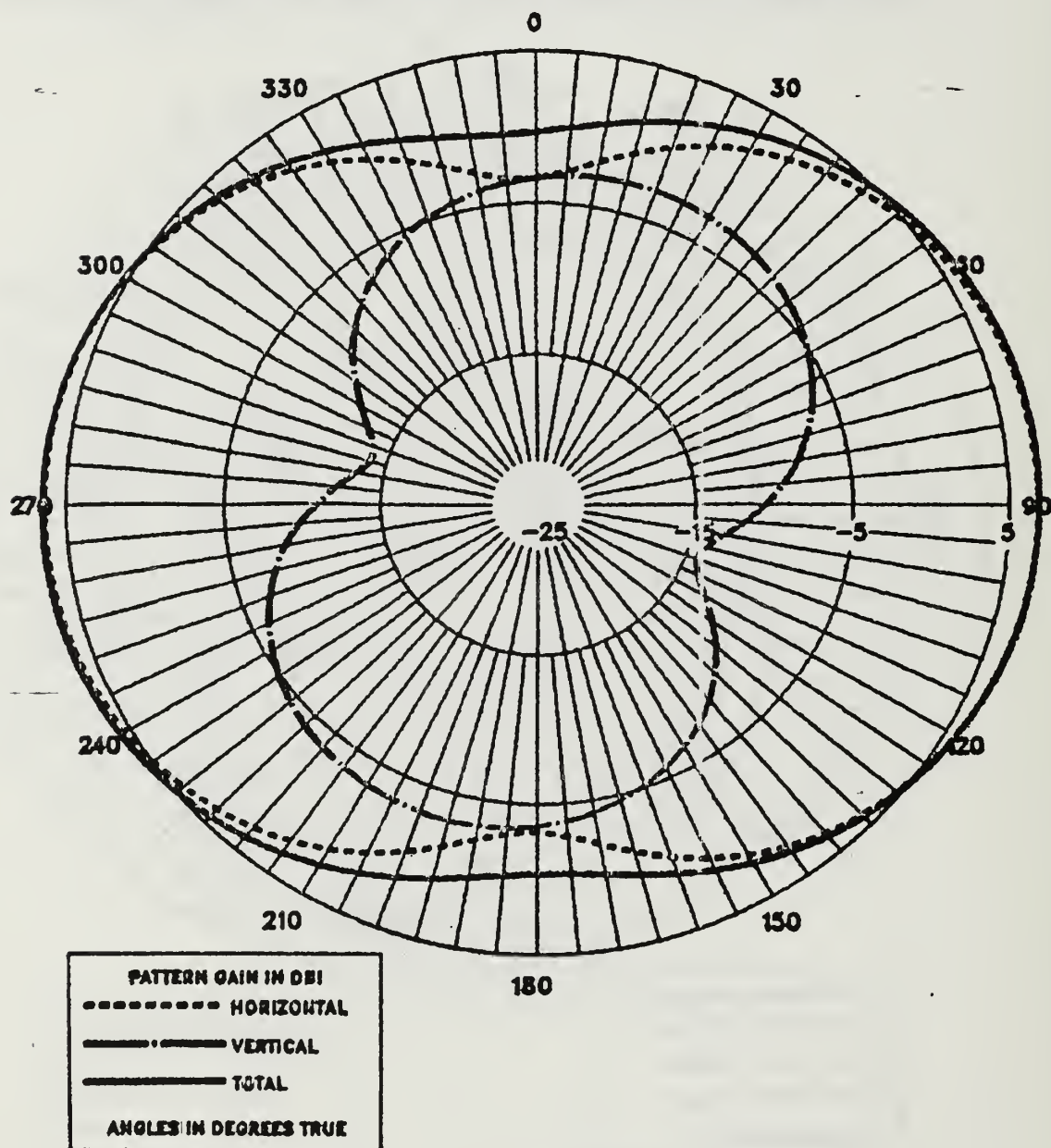
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LW SPACED 18" FROM A/C, FREE SPACE, VERT CUT, PHI=45



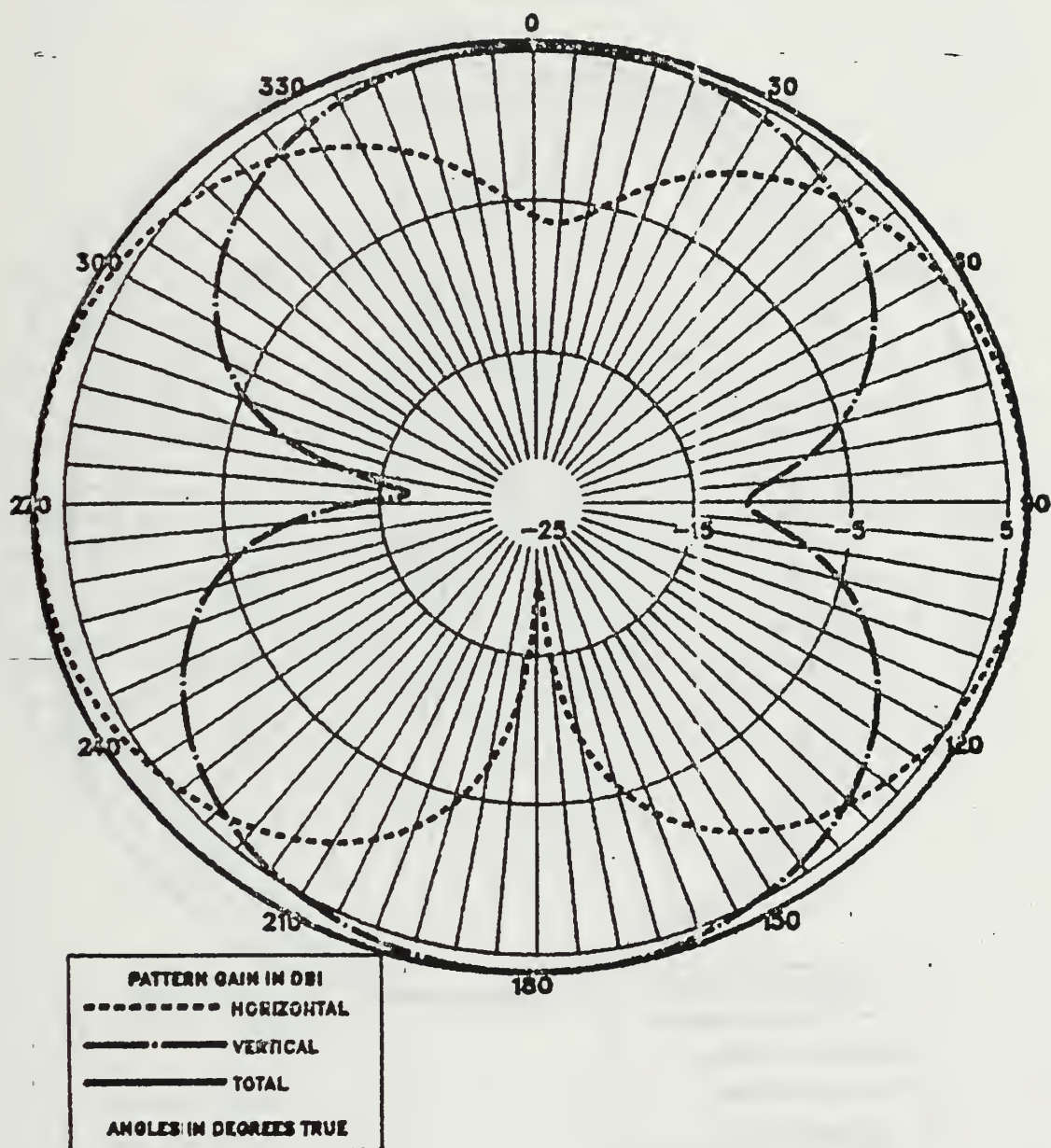
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NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



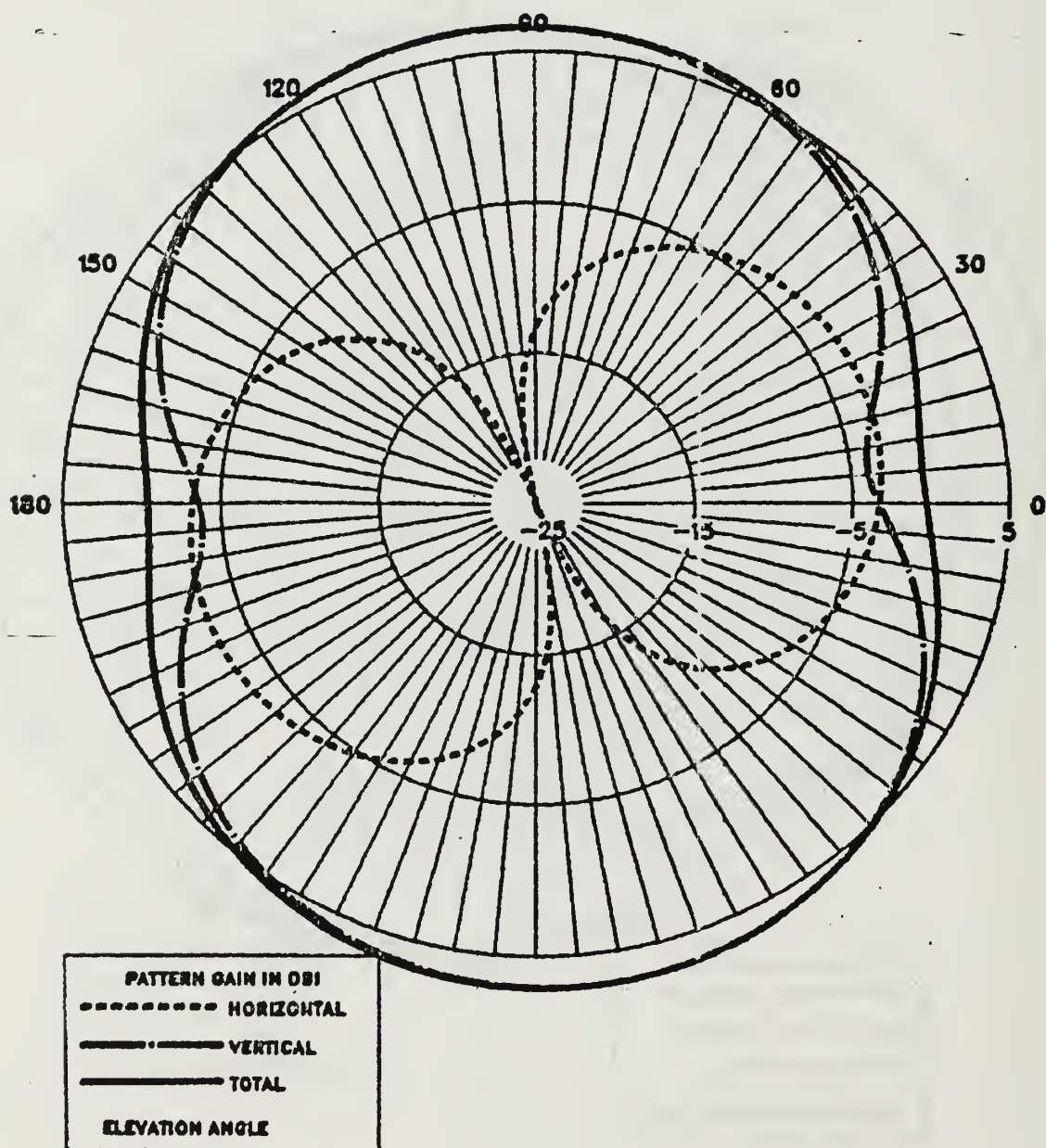
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NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



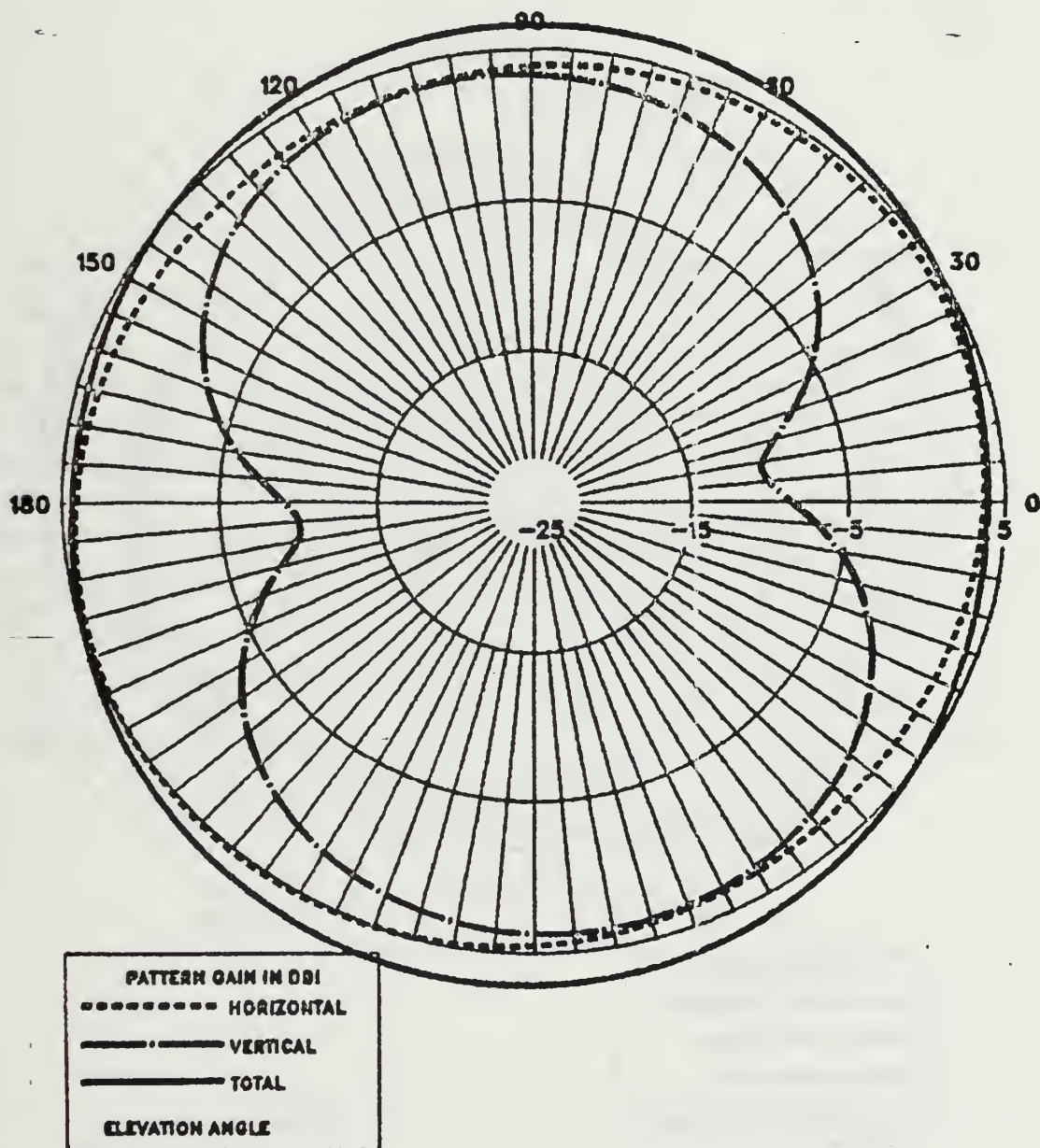
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NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



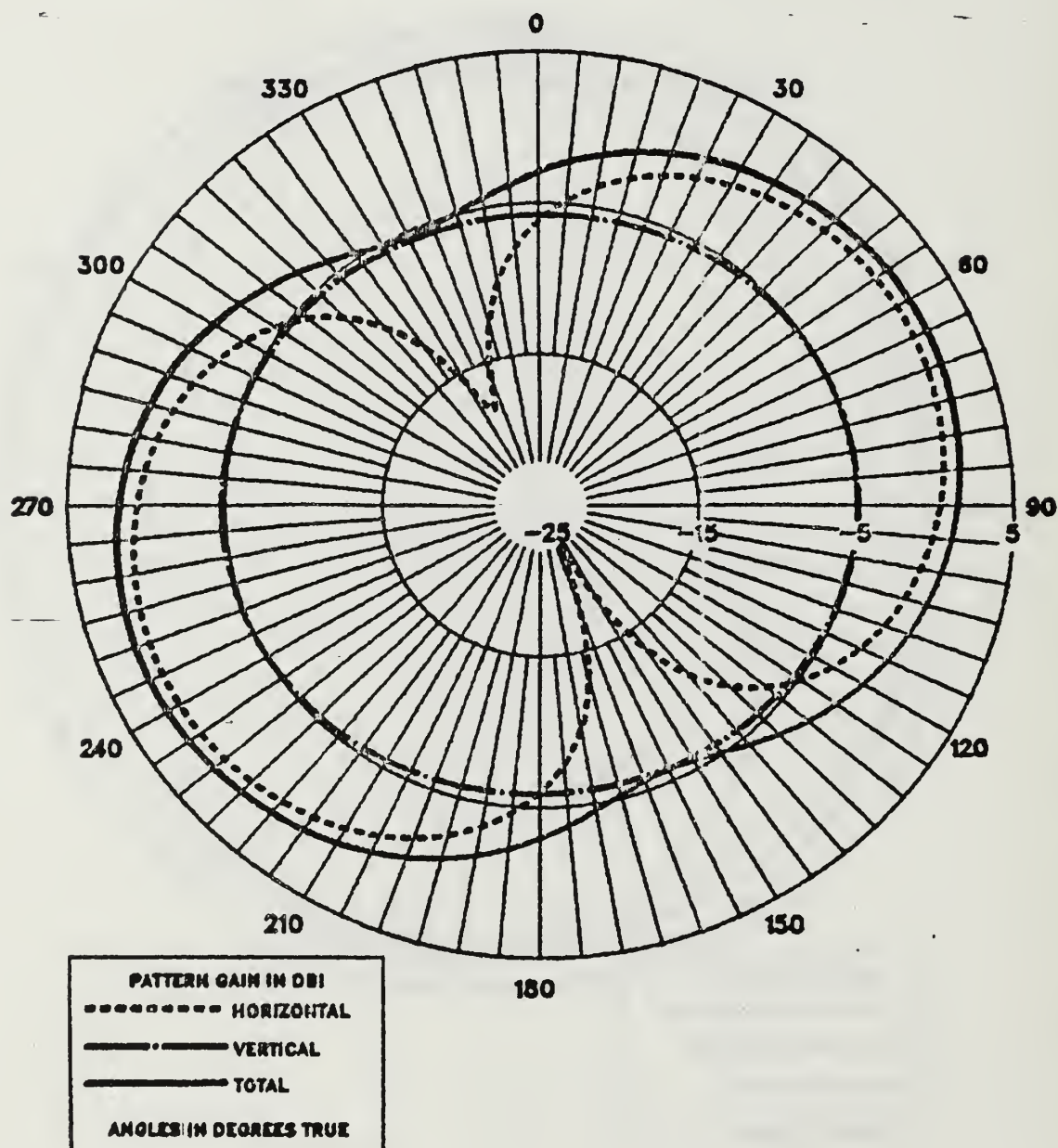
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NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



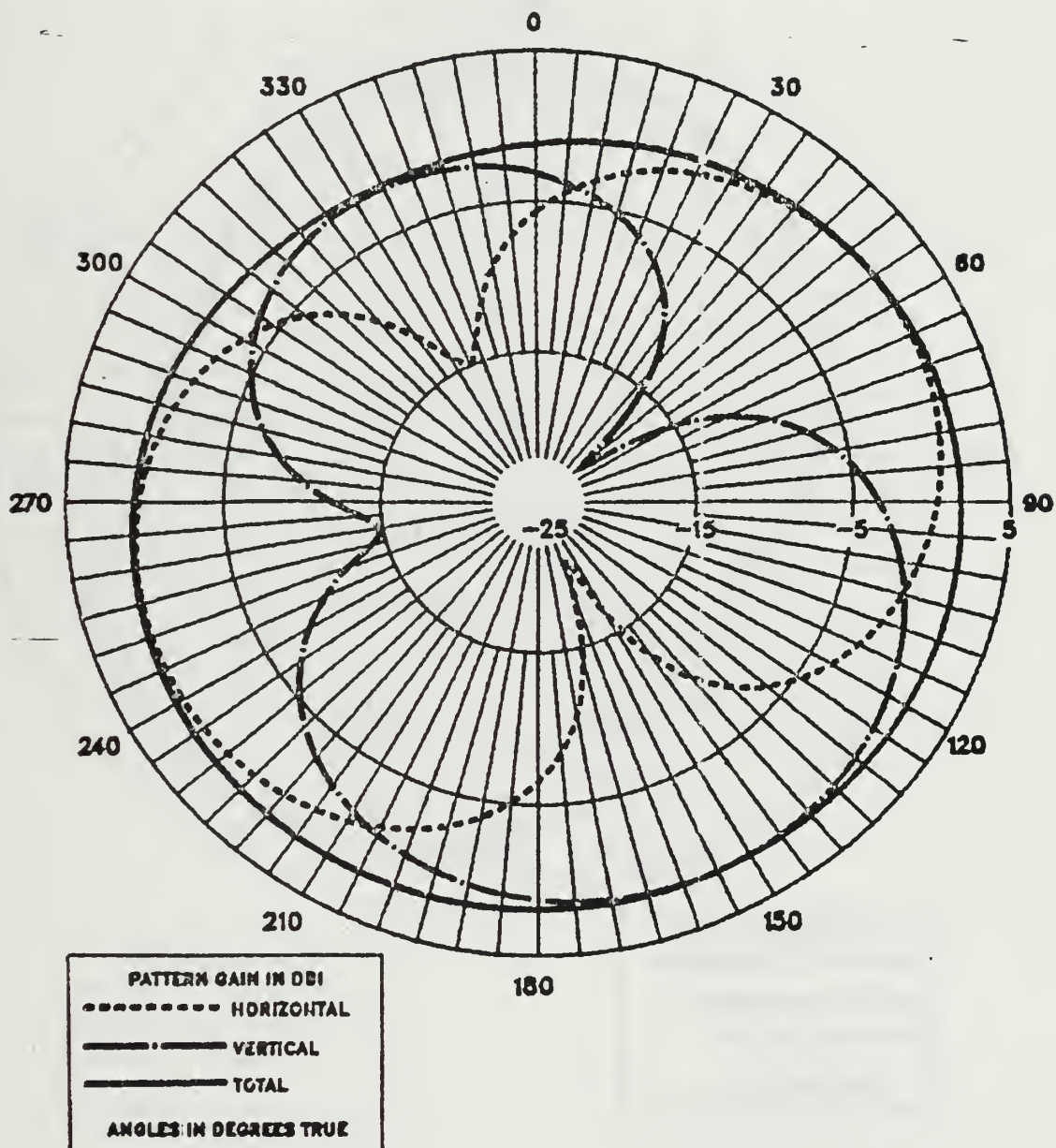
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



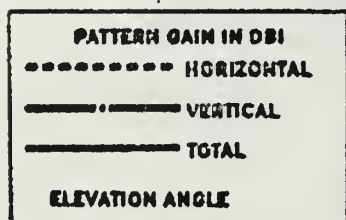
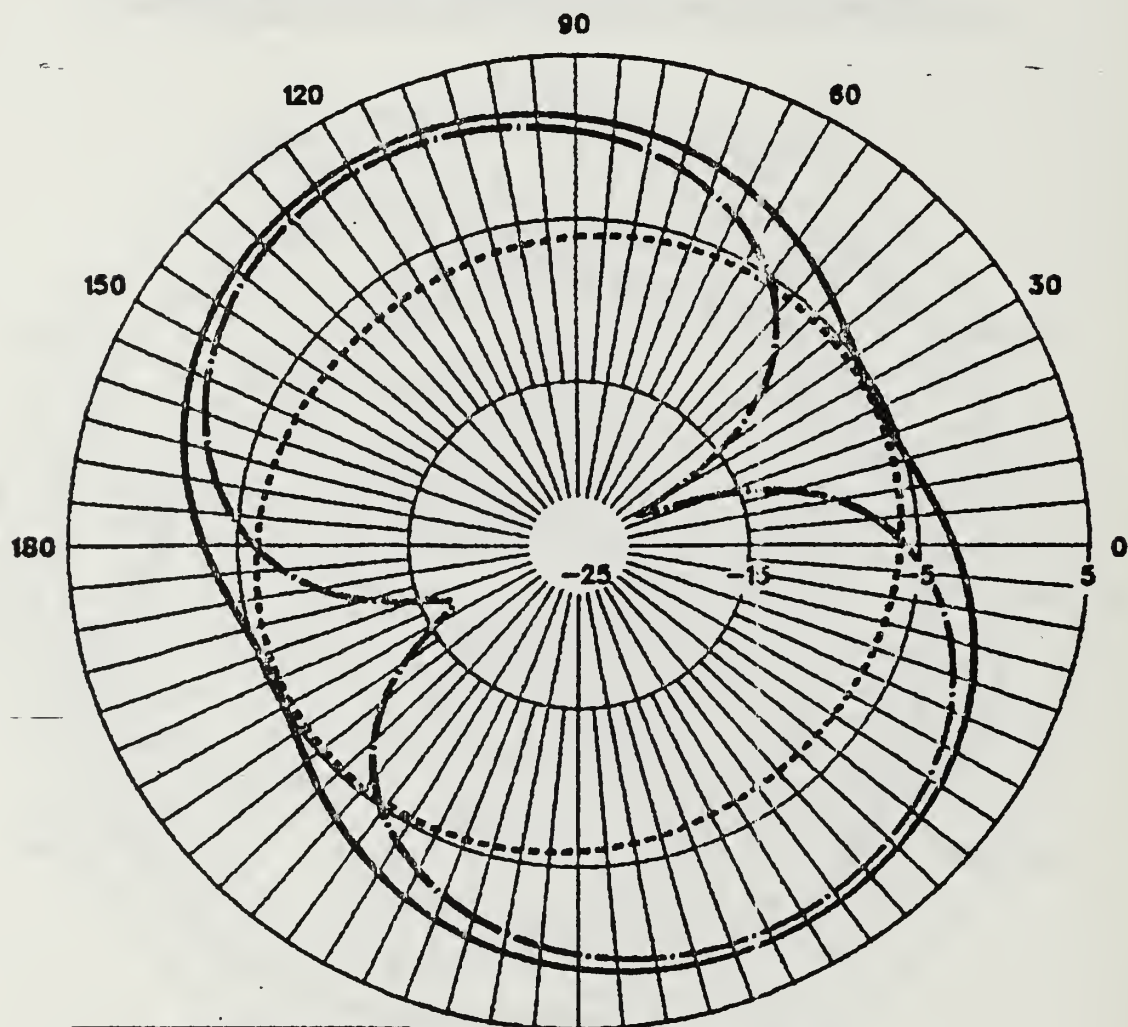
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



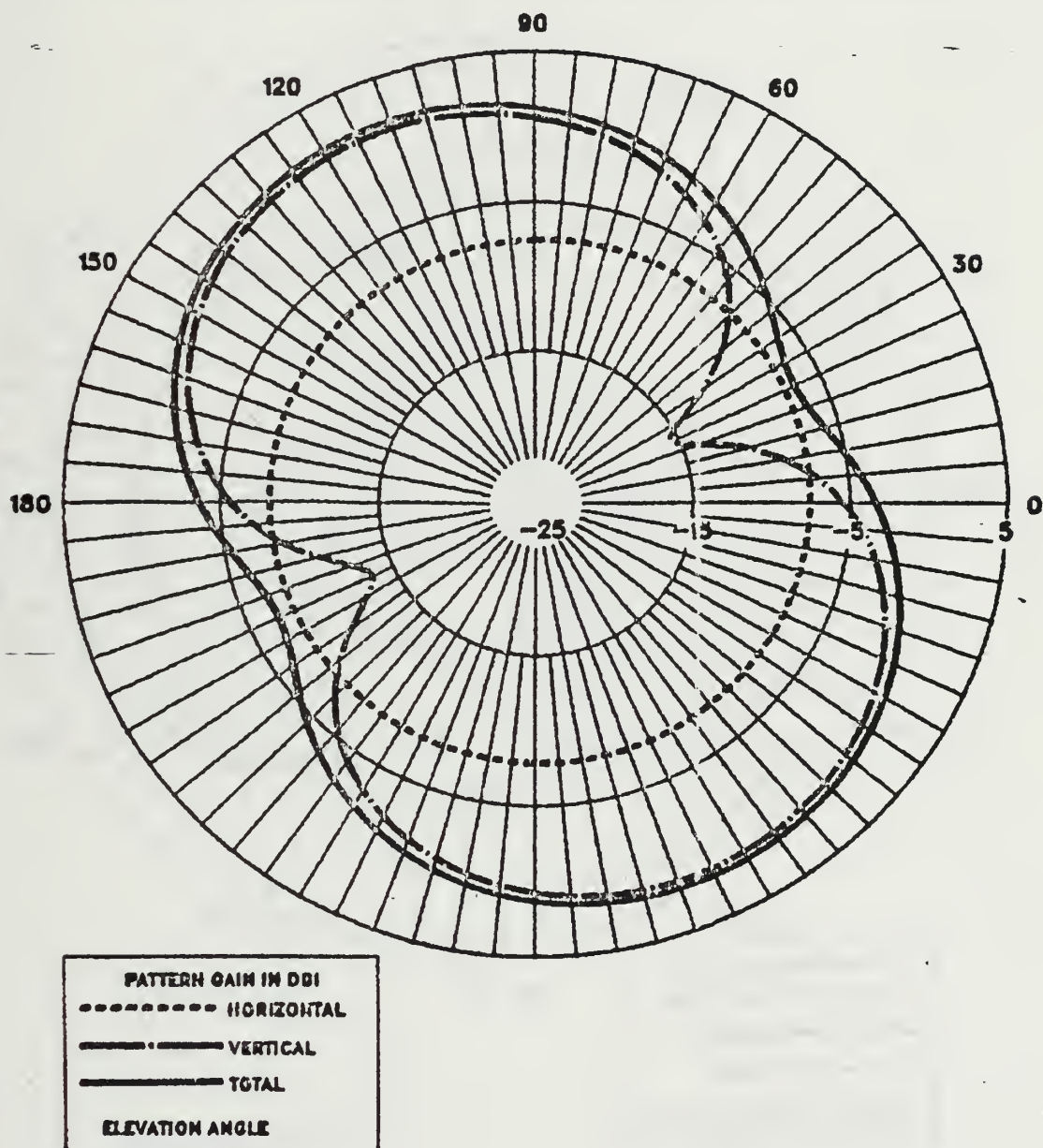
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



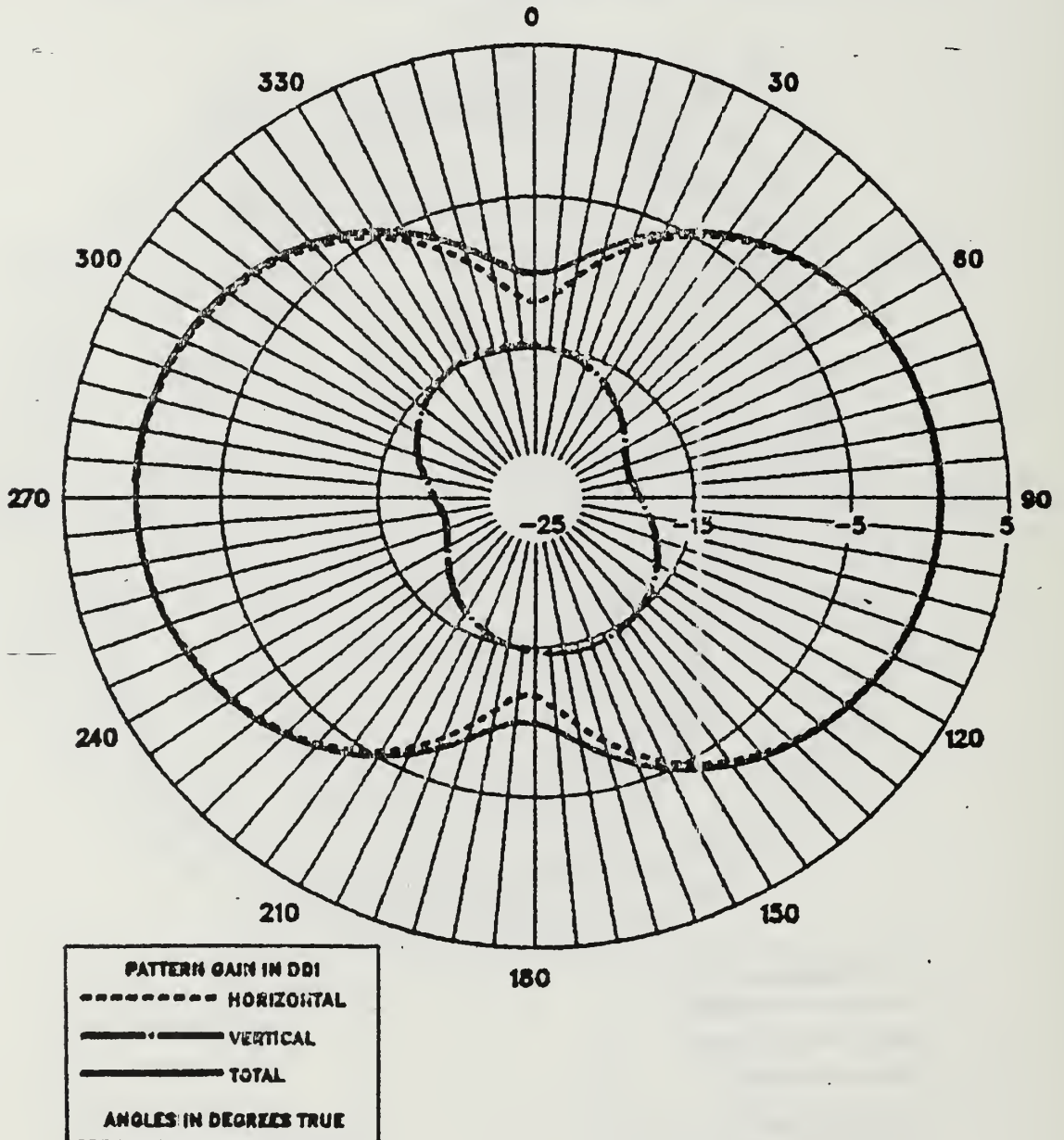
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



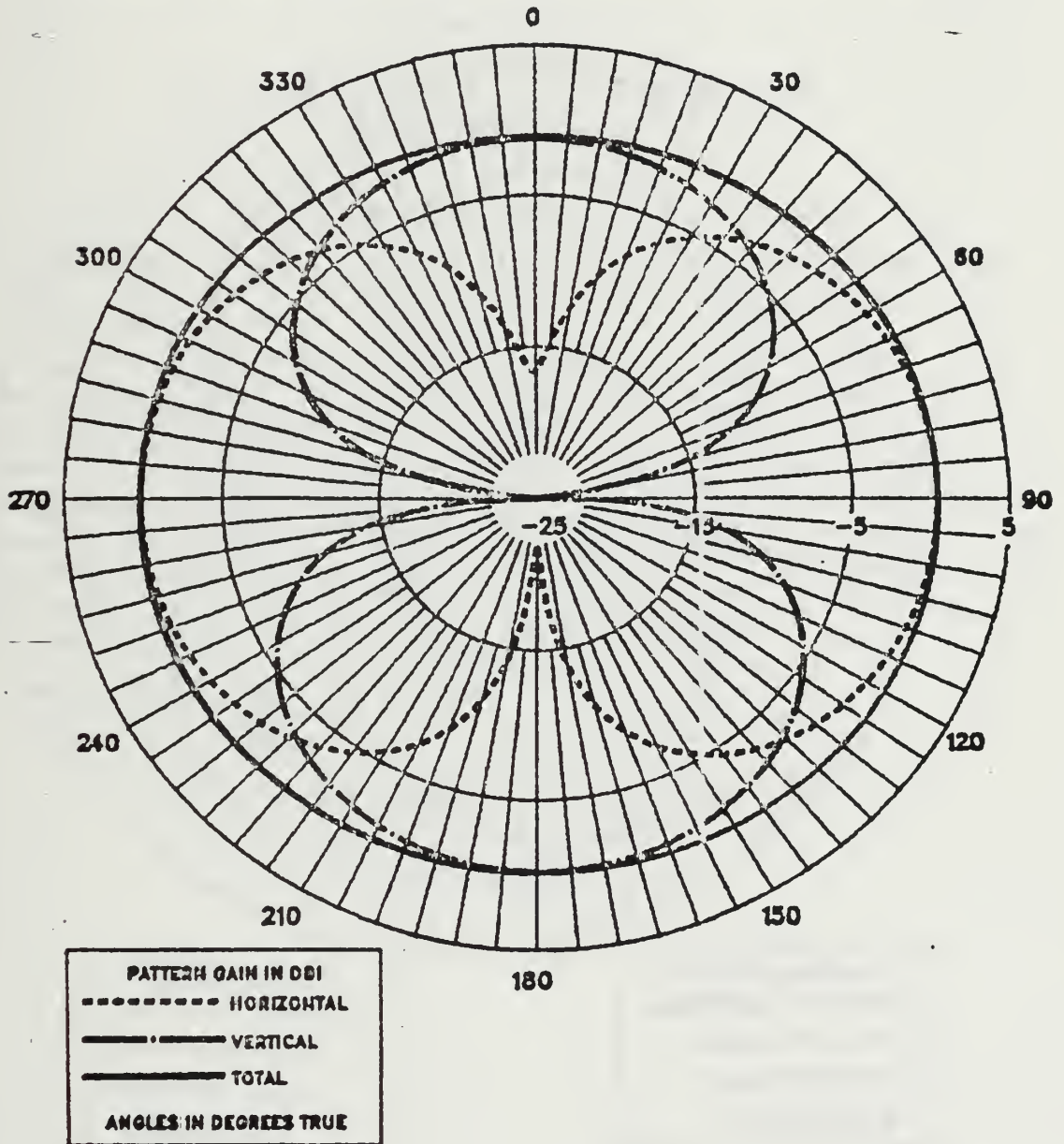
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



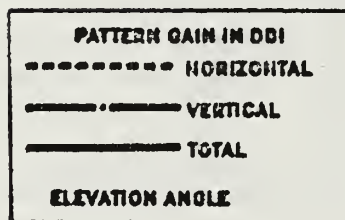
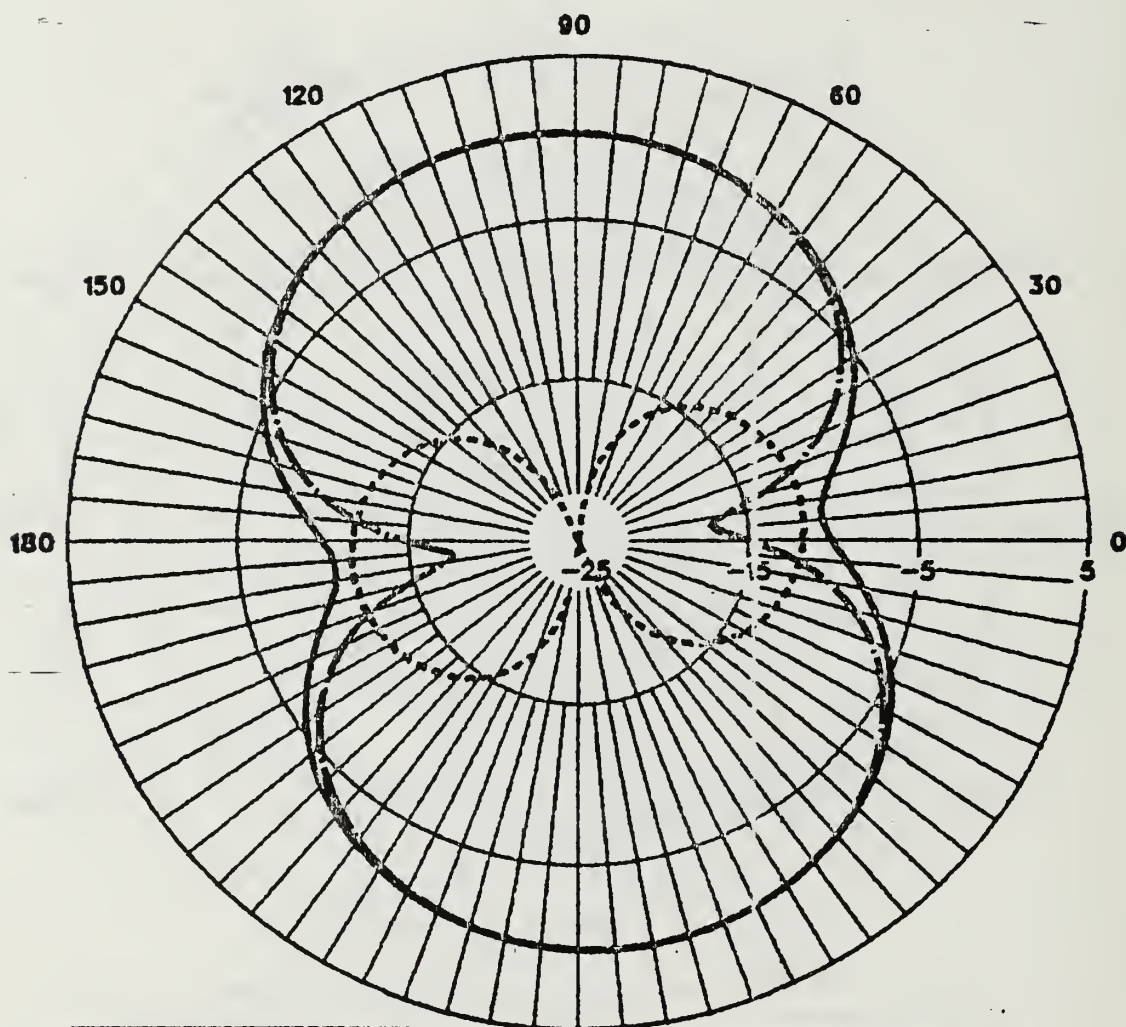
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



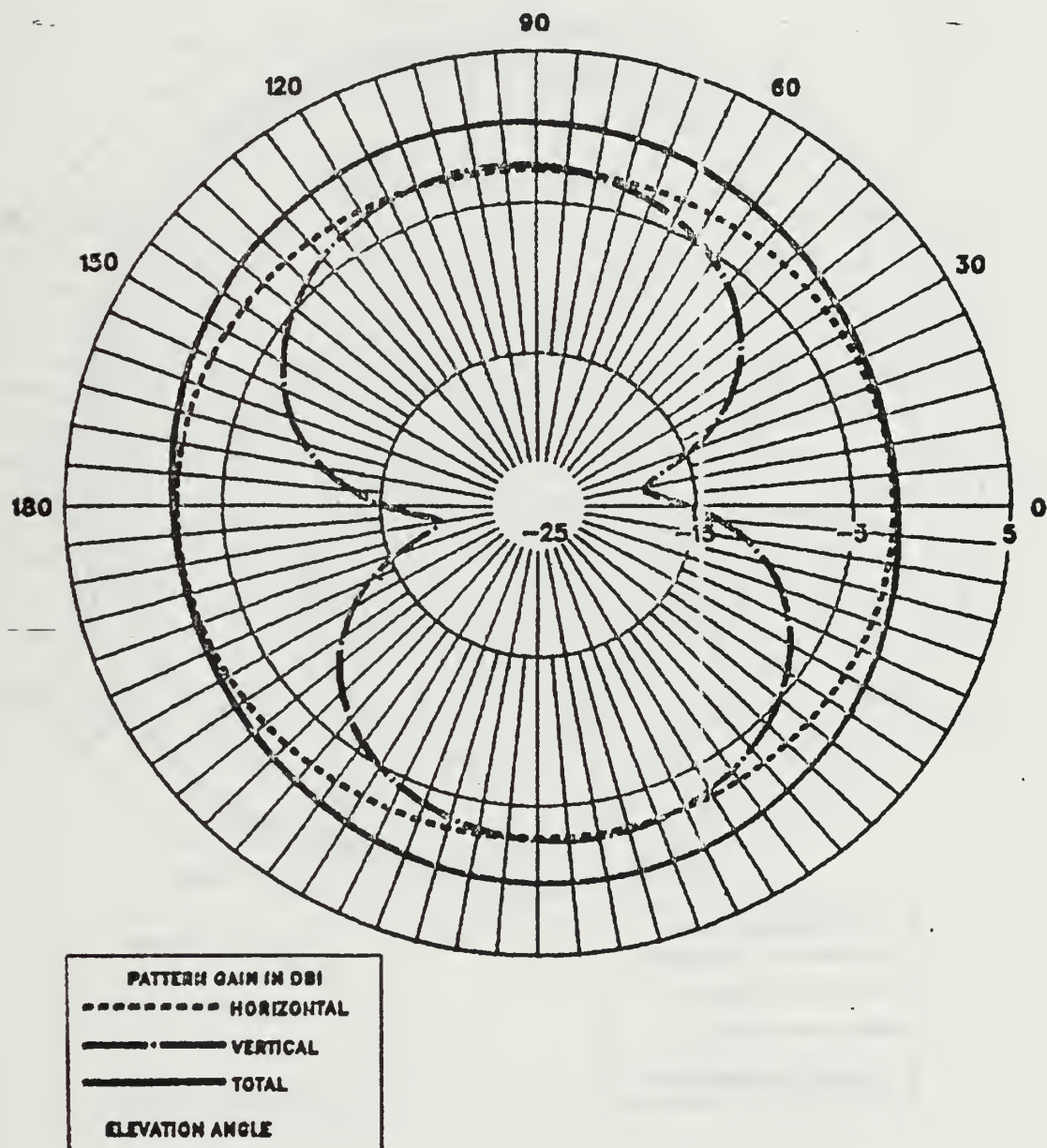
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



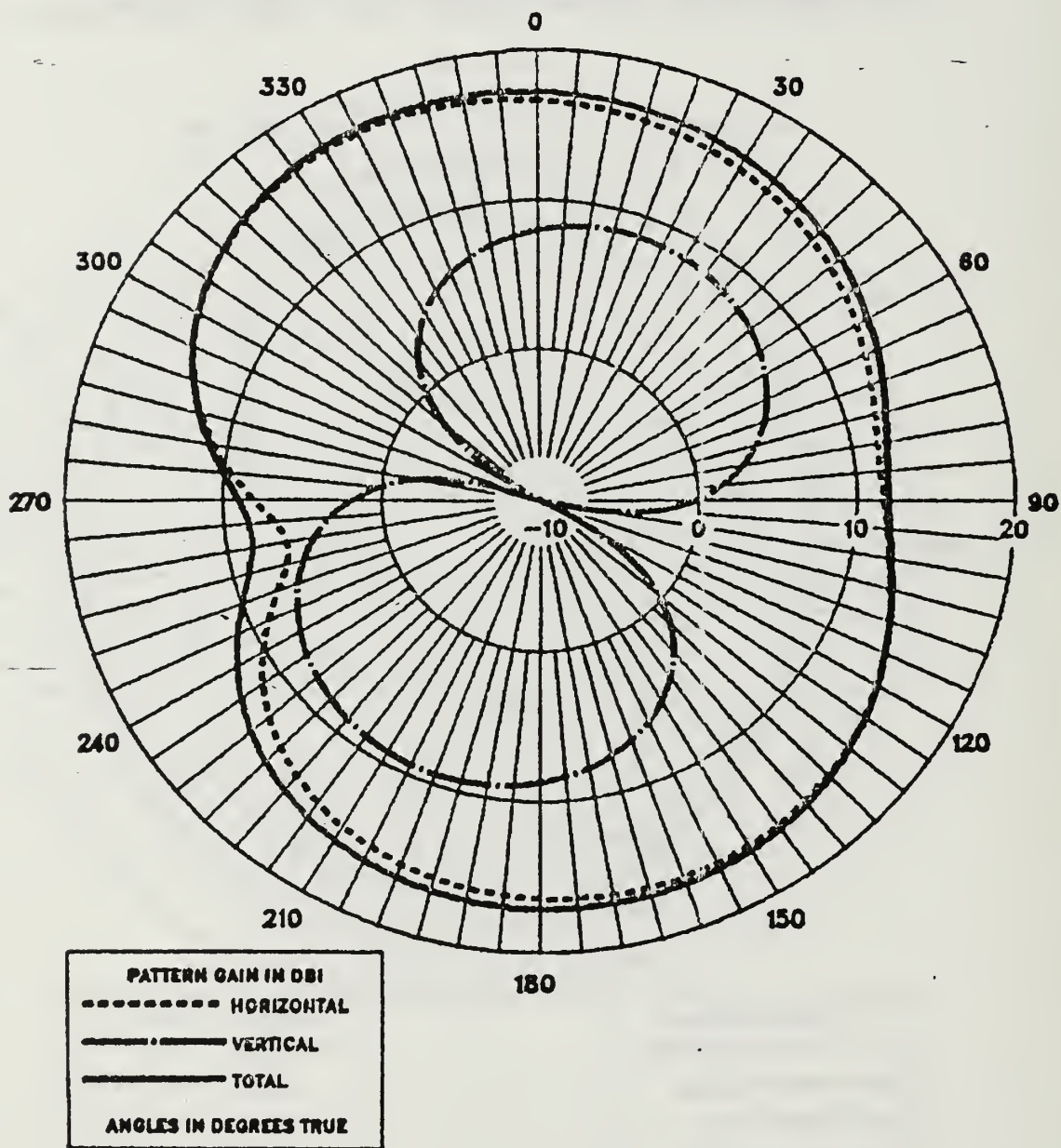
H60 IGUANA DATA RUN AT 4.040MHZ ON 8/18/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



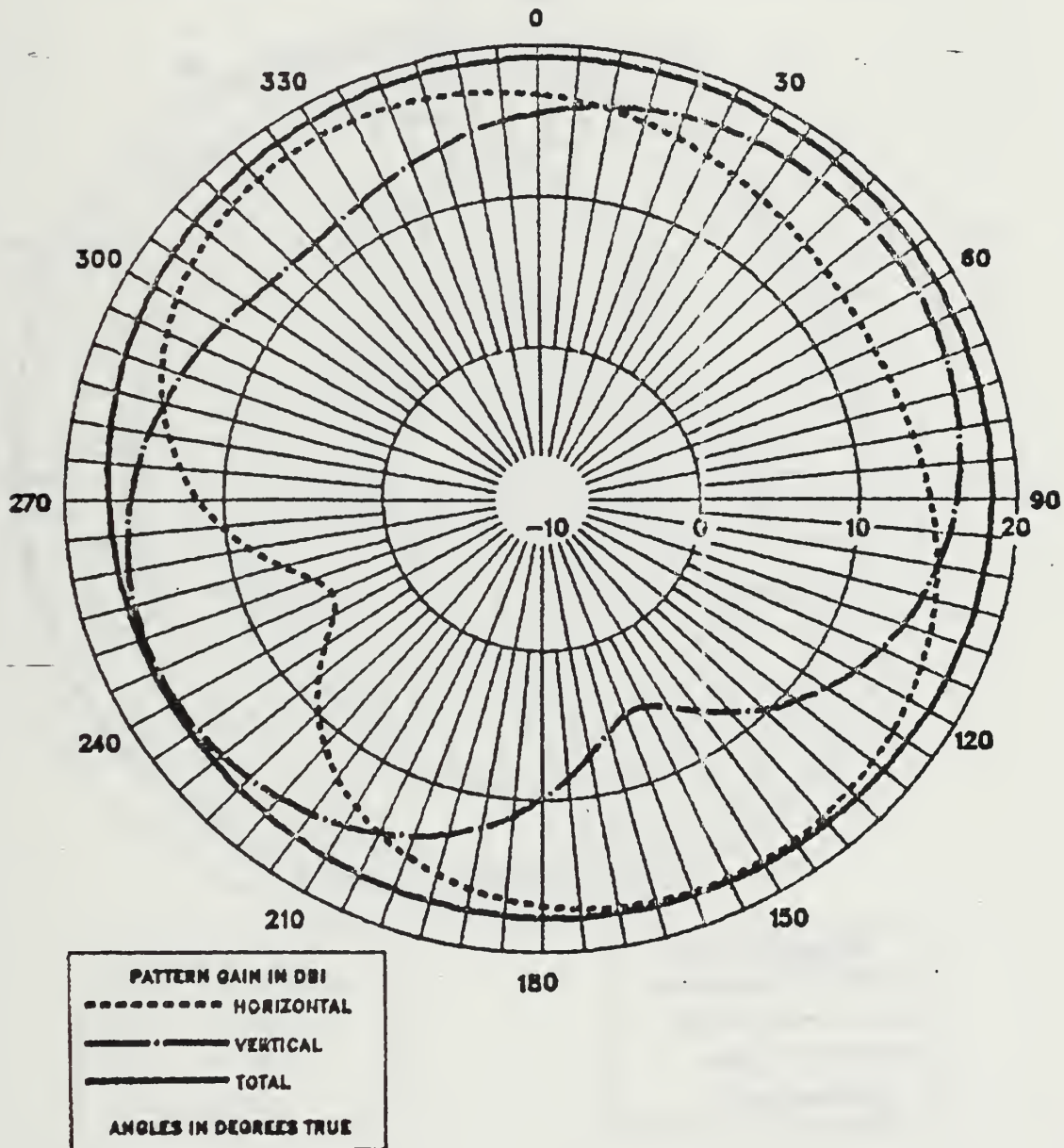
H60 IGUANA DATA RUN AT 5.696MHz ON 8/20/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



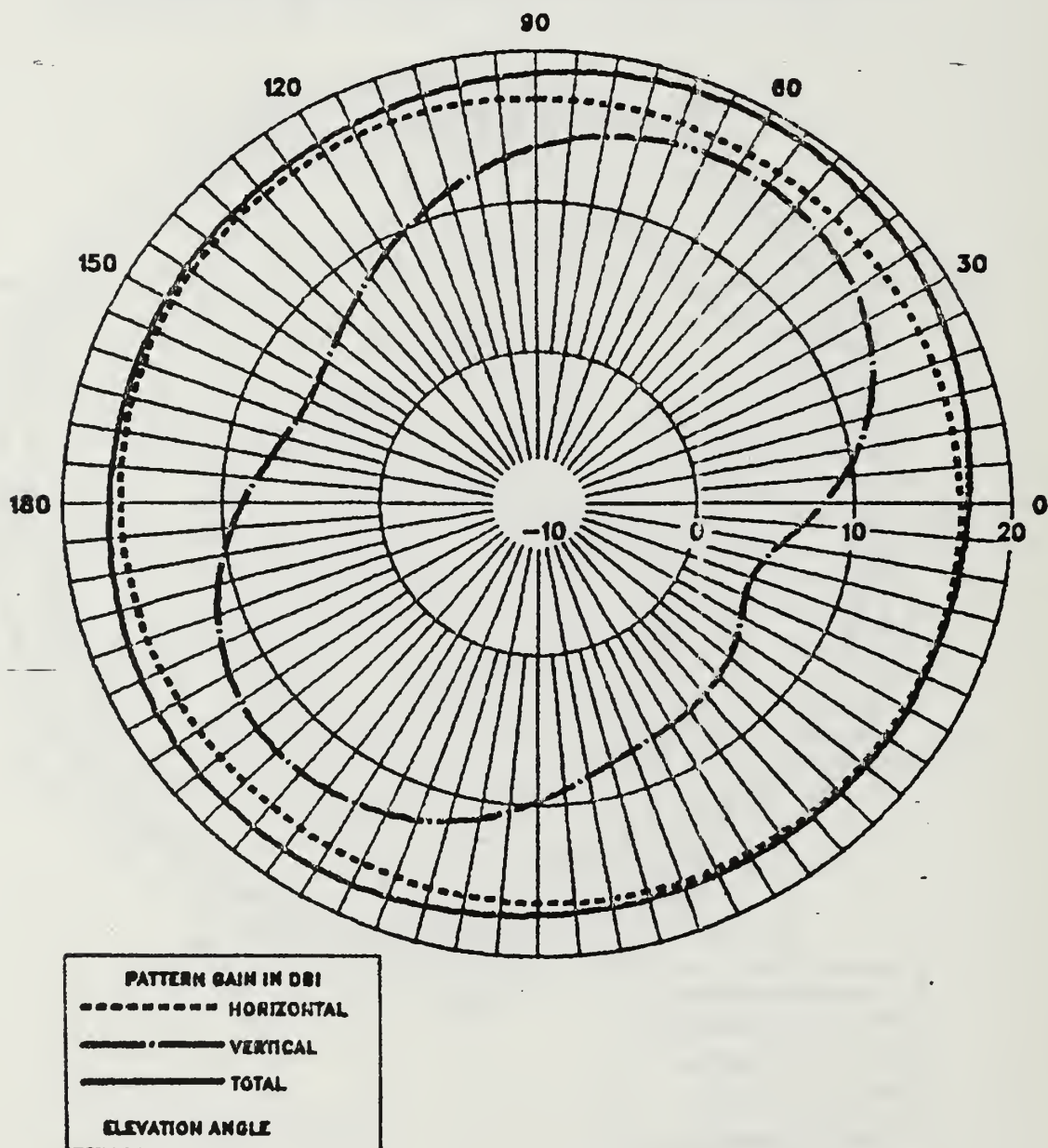
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



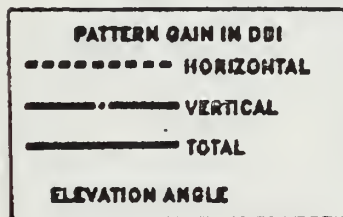
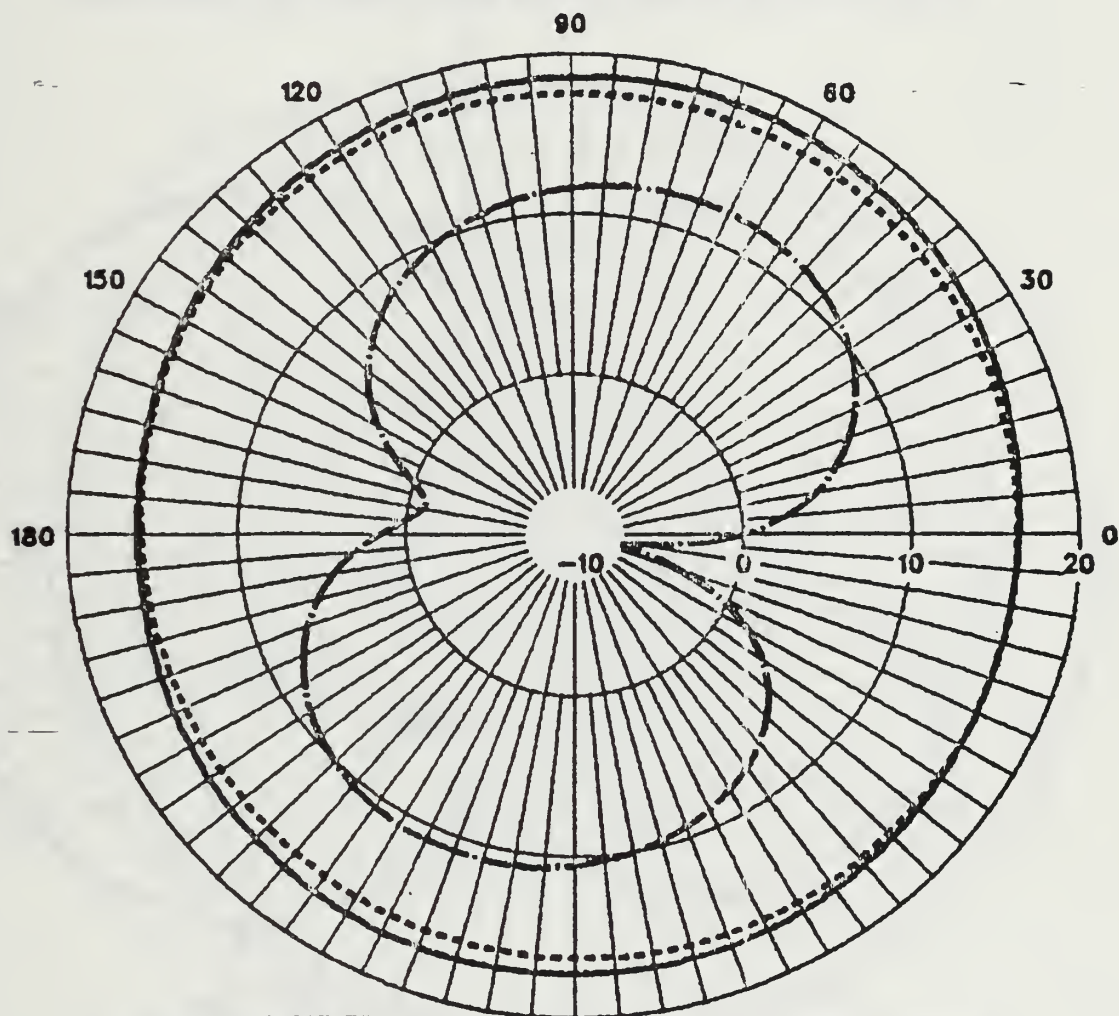
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, $\Phi=0$



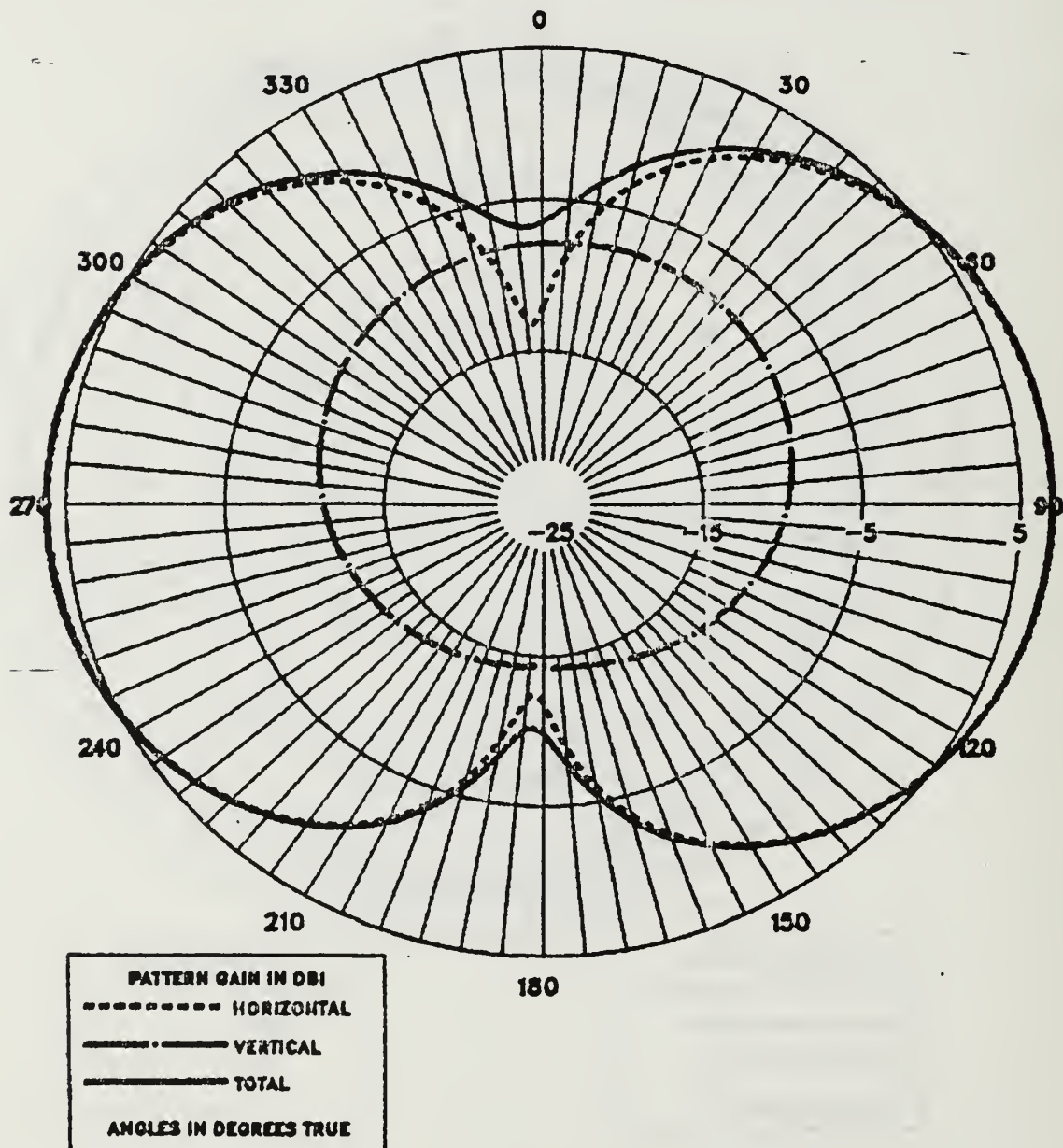
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



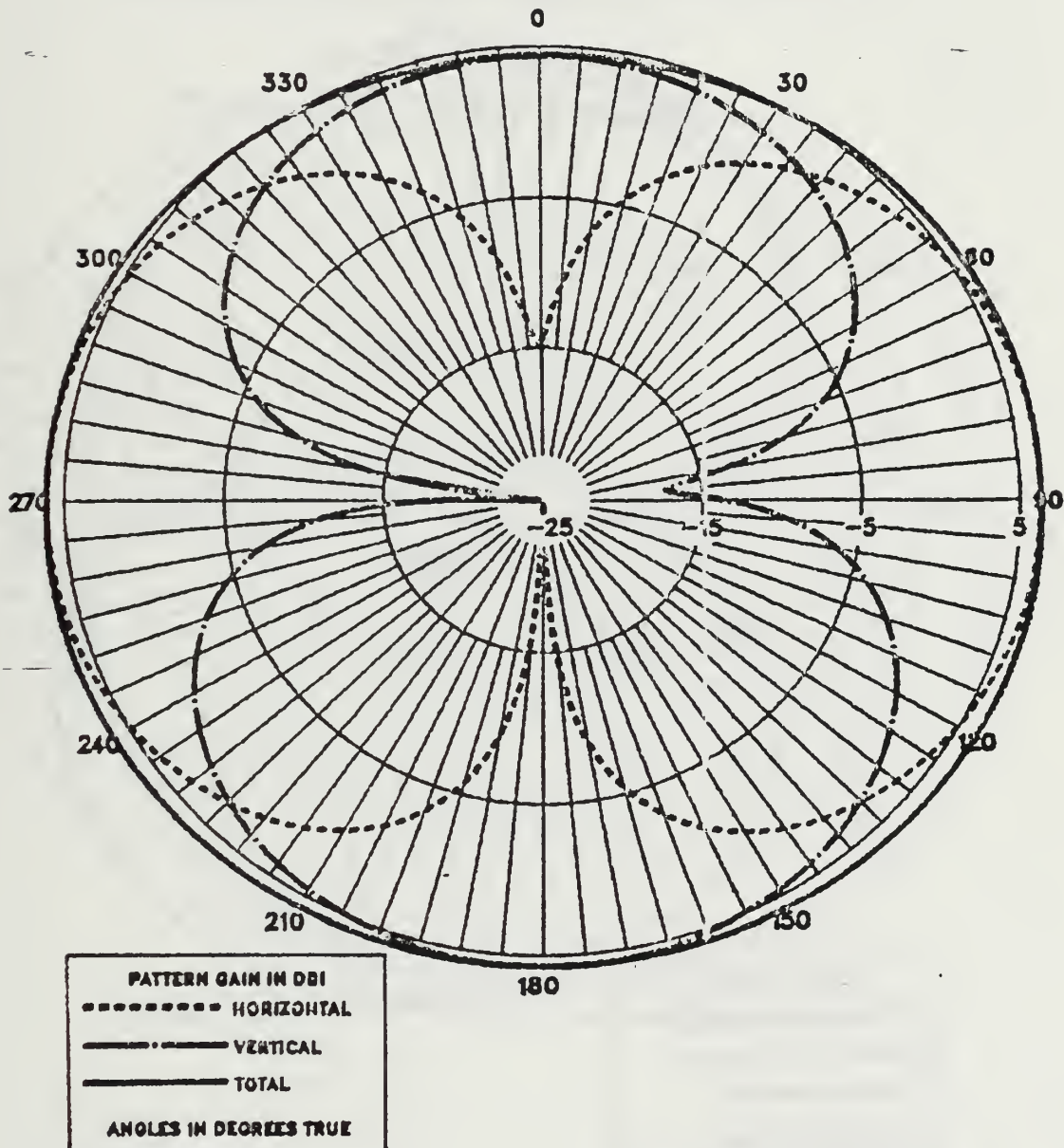
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

NAVY 437R-2, FREE SPACE, HORIZ CUT, THETA=90



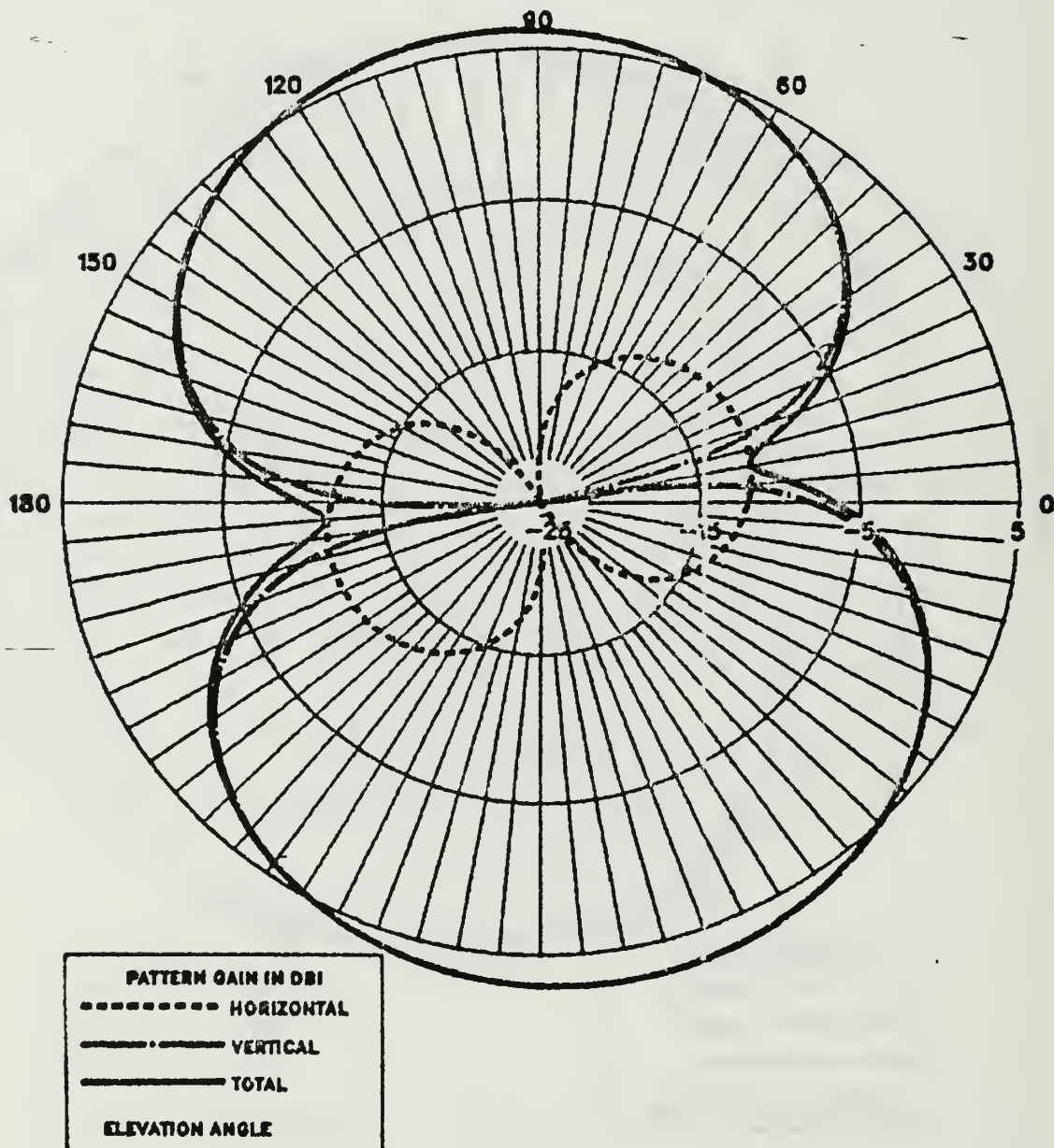
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NAVY 437R-2, FREE SPACE, HORIZ CUT, THETA=26

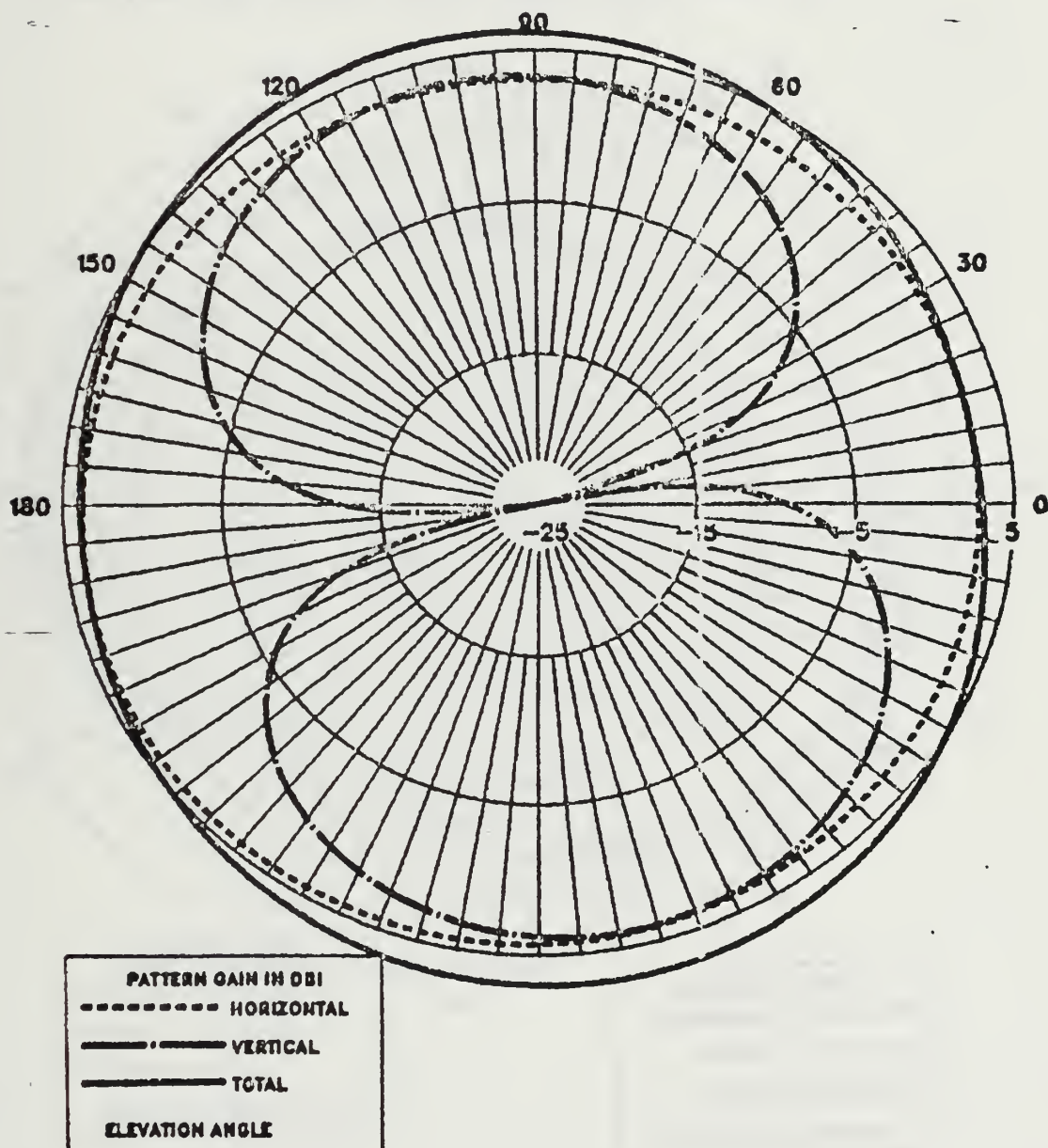


H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

NAVY 437R-2, FREE SPACE, VERT CUT, PHI=0

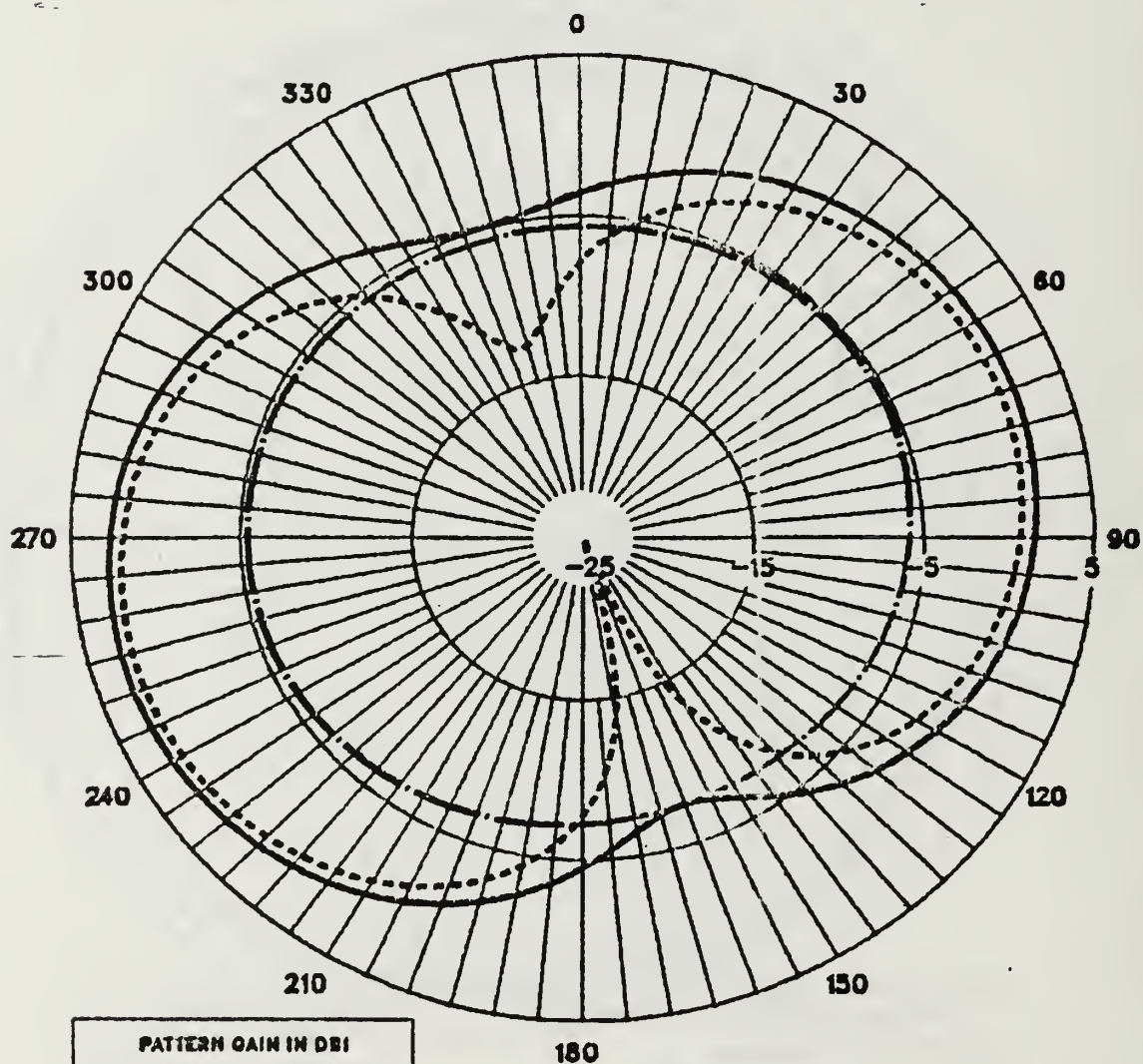


NAVY 437R-2, FREE SPACE, VERT CUT, PHI=45



H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

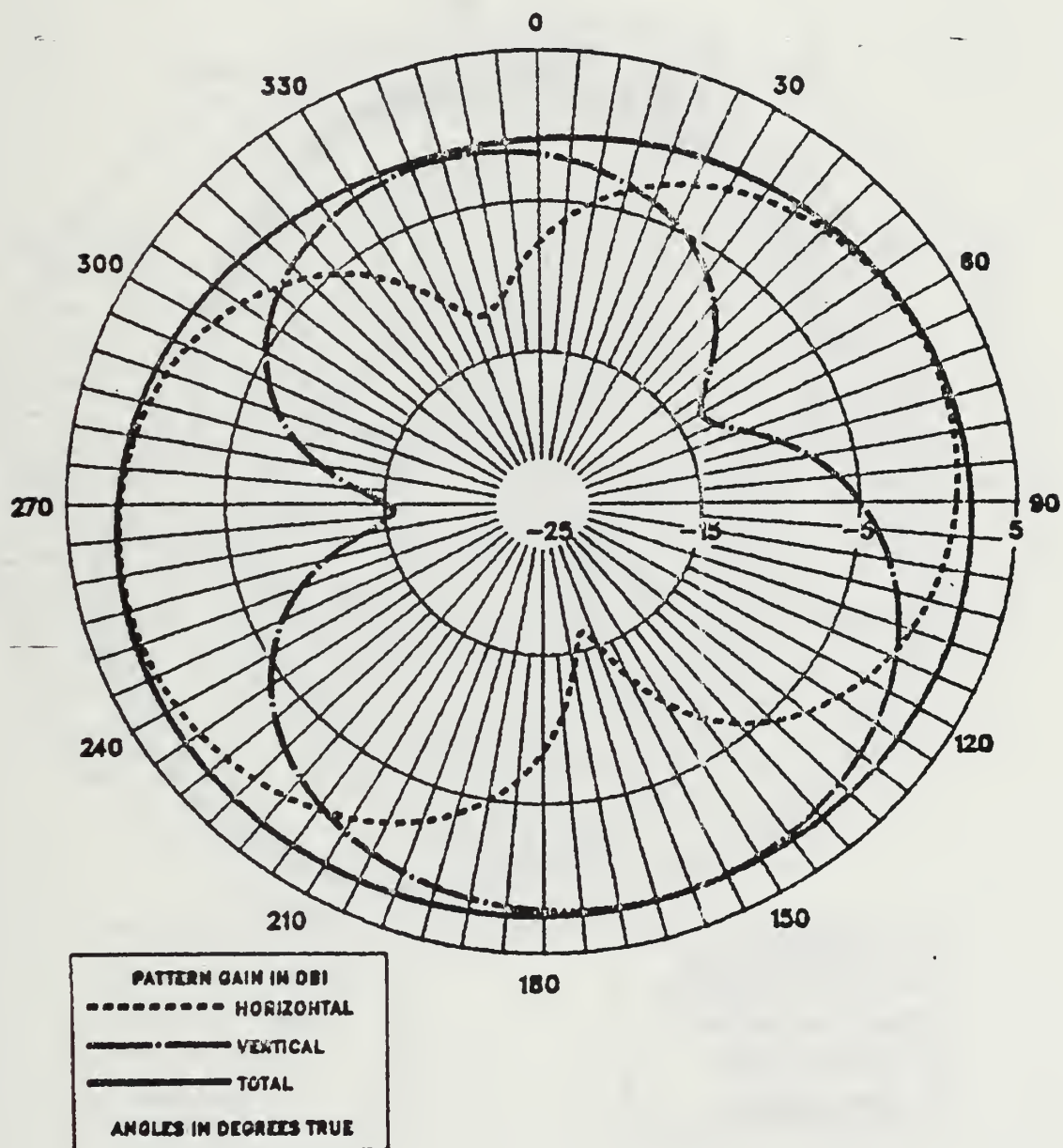
CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



PATTERN GAIN IN DBI
----- HORIZONTAL
----- VERTICAL
----- TOTAL
ANGLES IN DEGREES TRUE

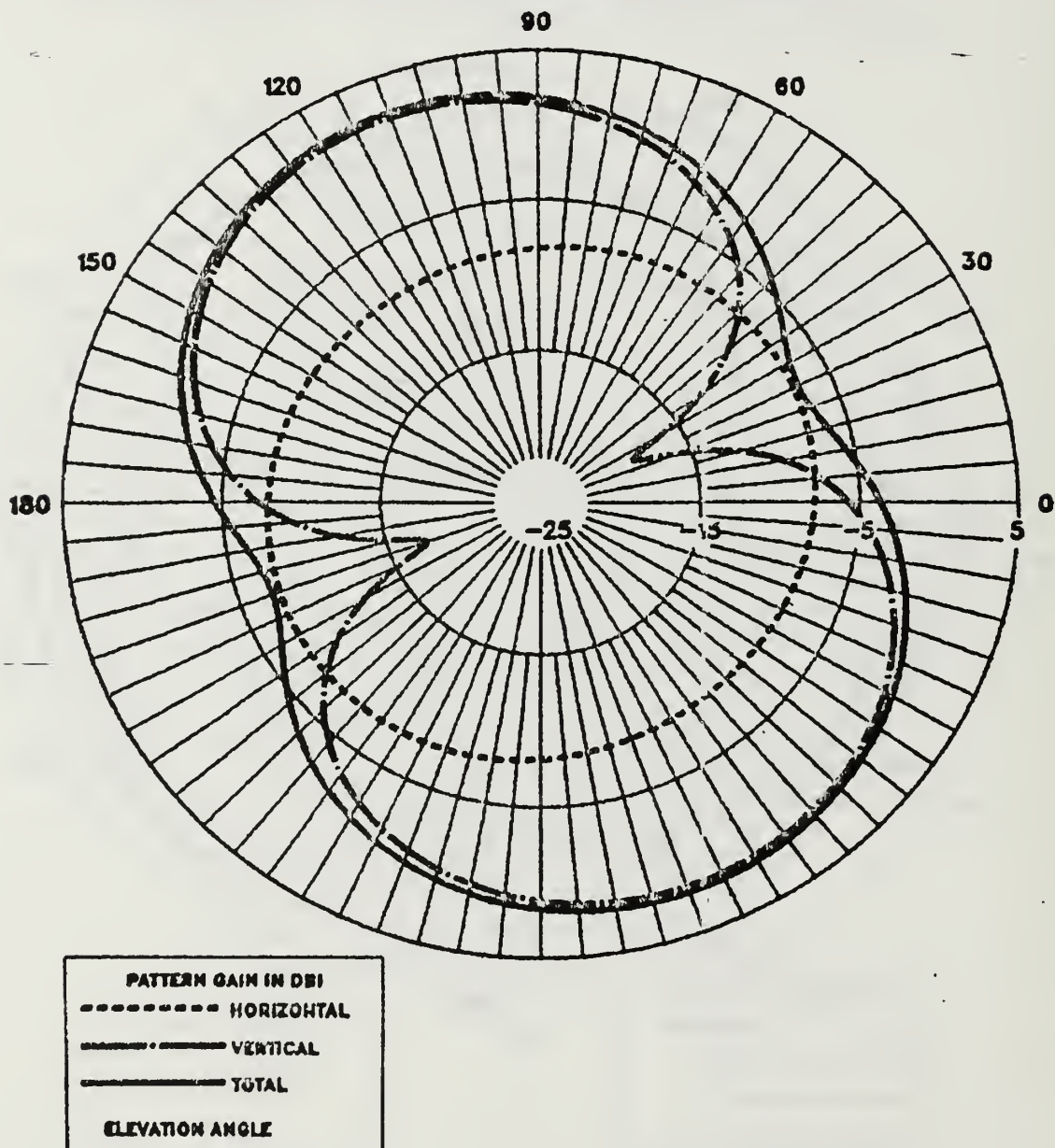
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



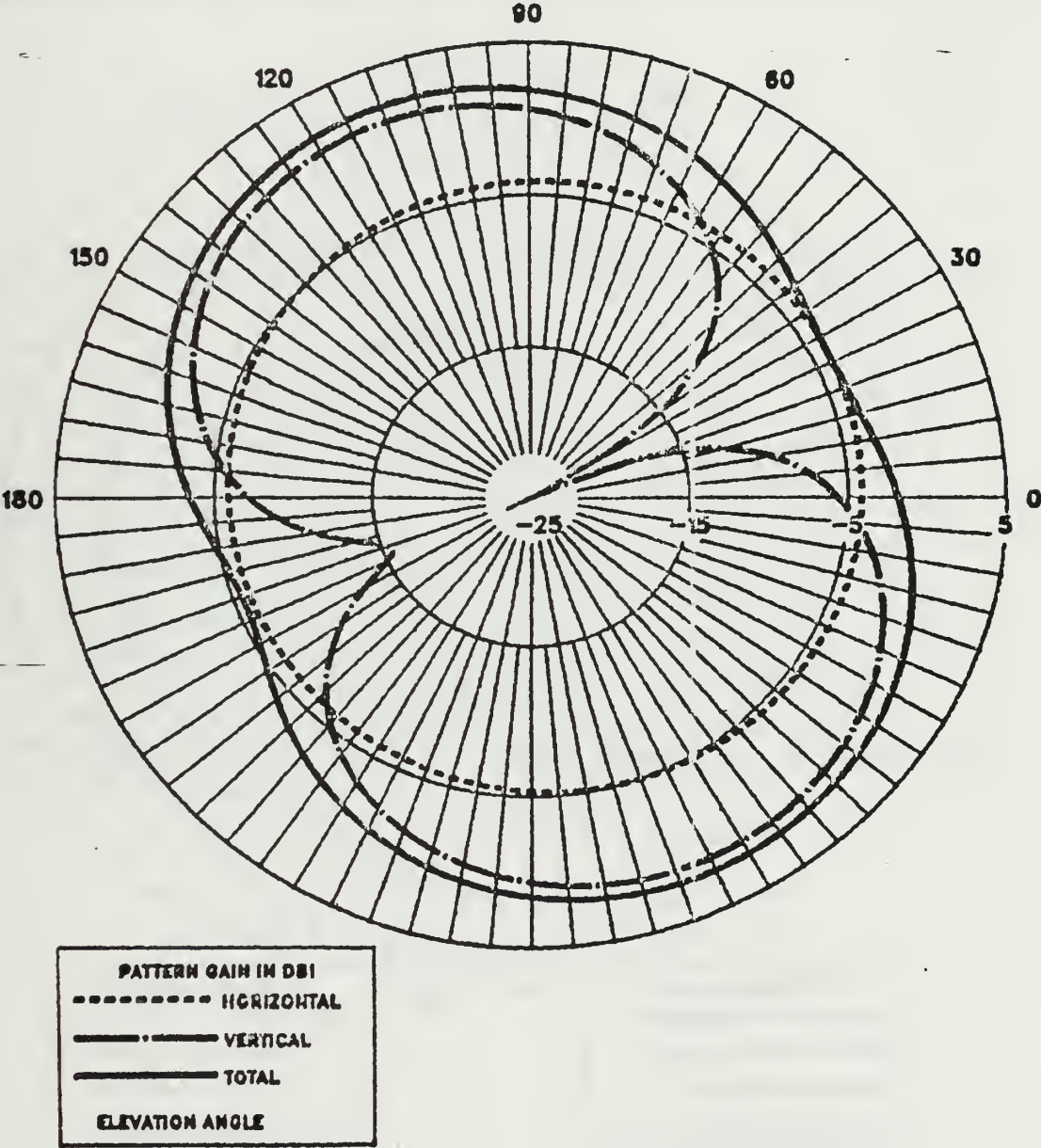
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



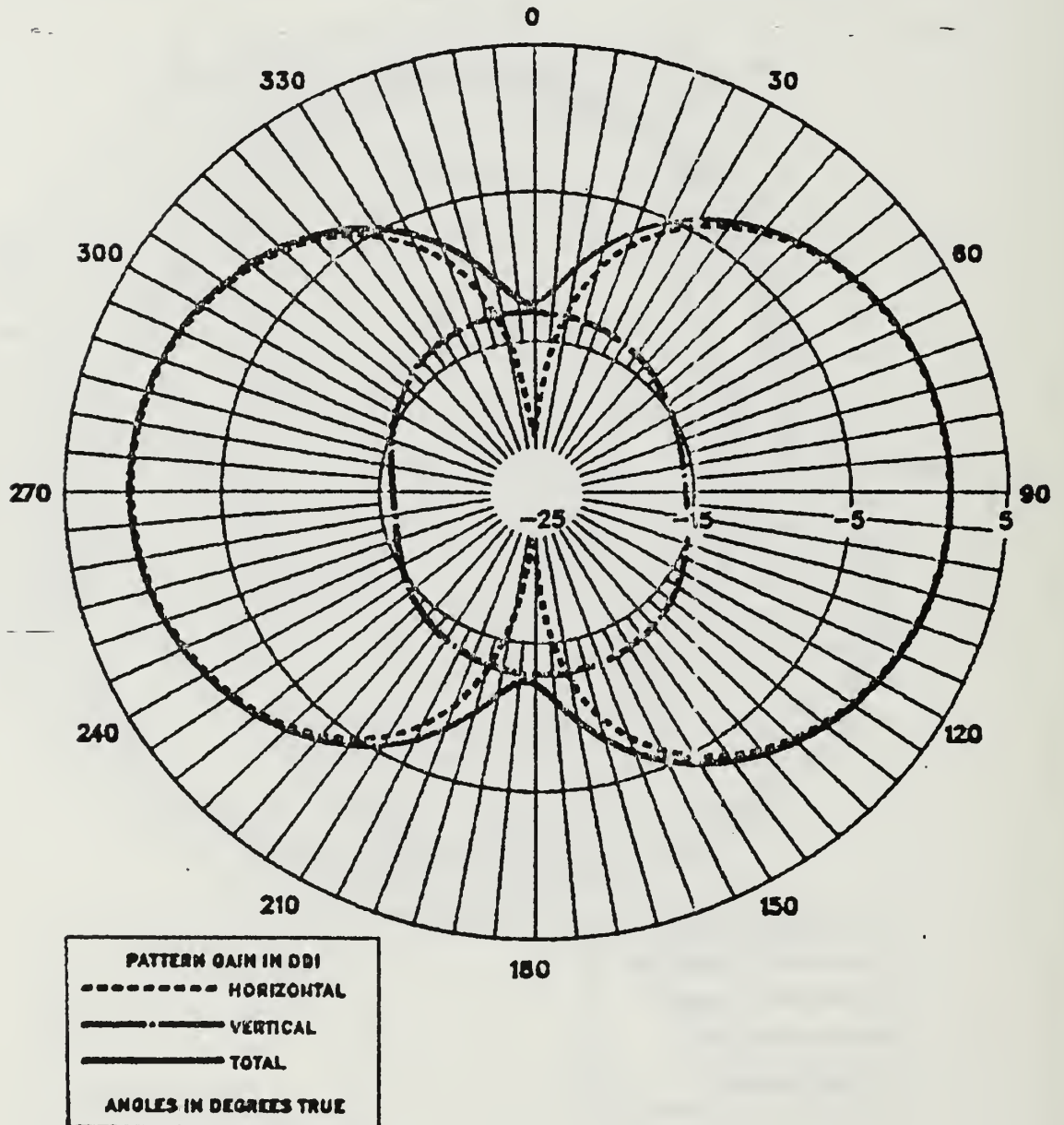
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



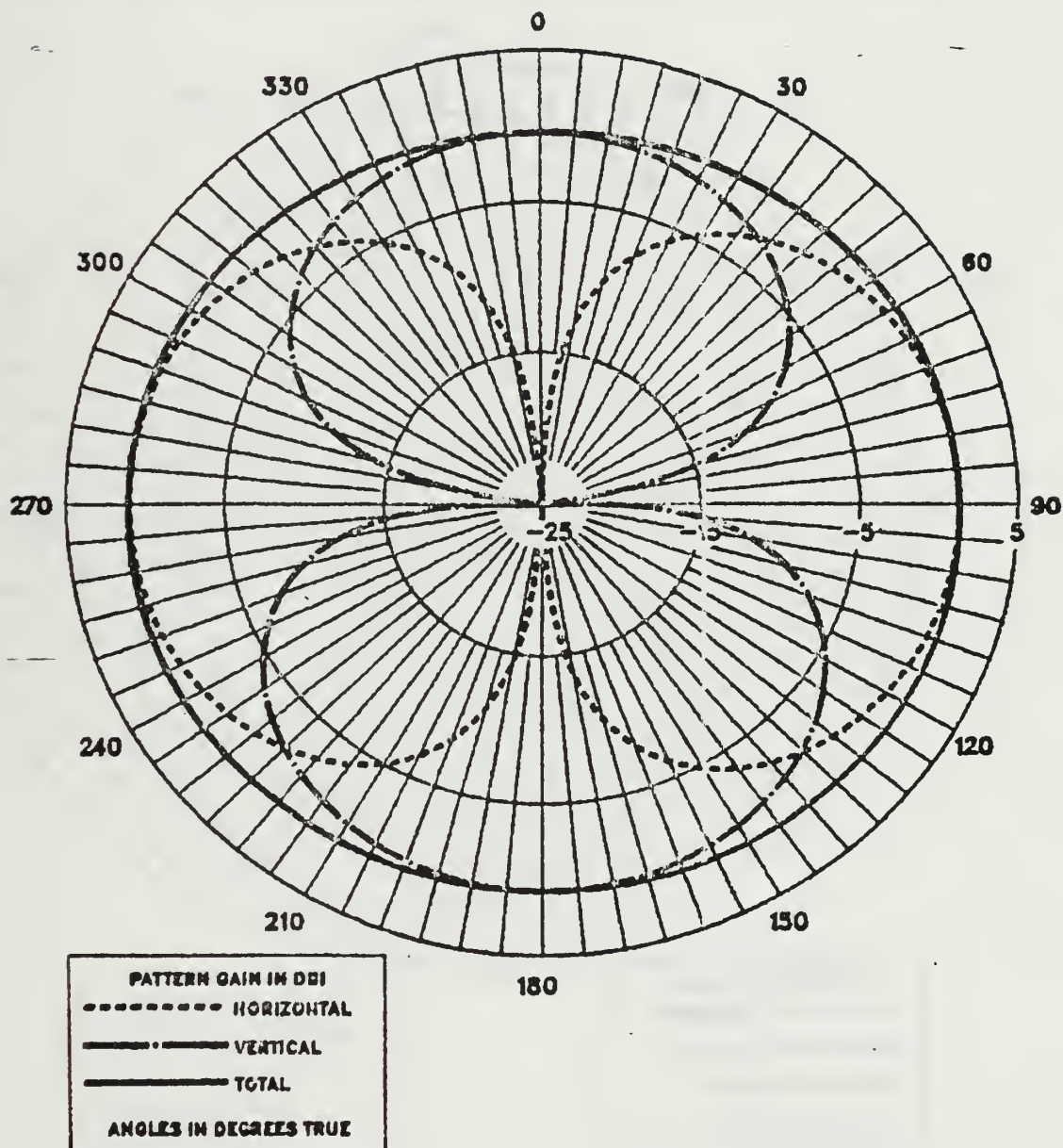
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



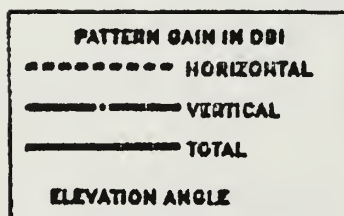
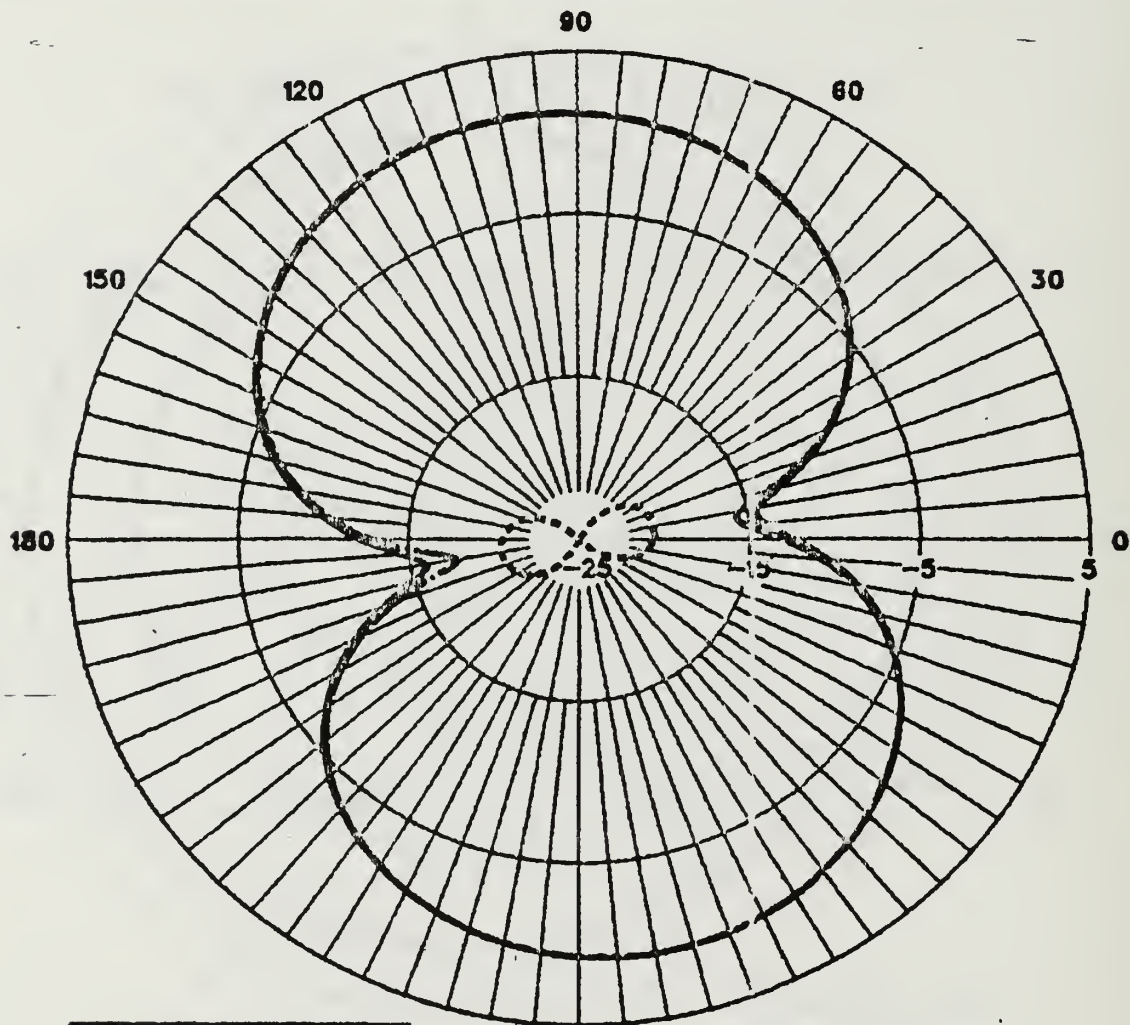
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



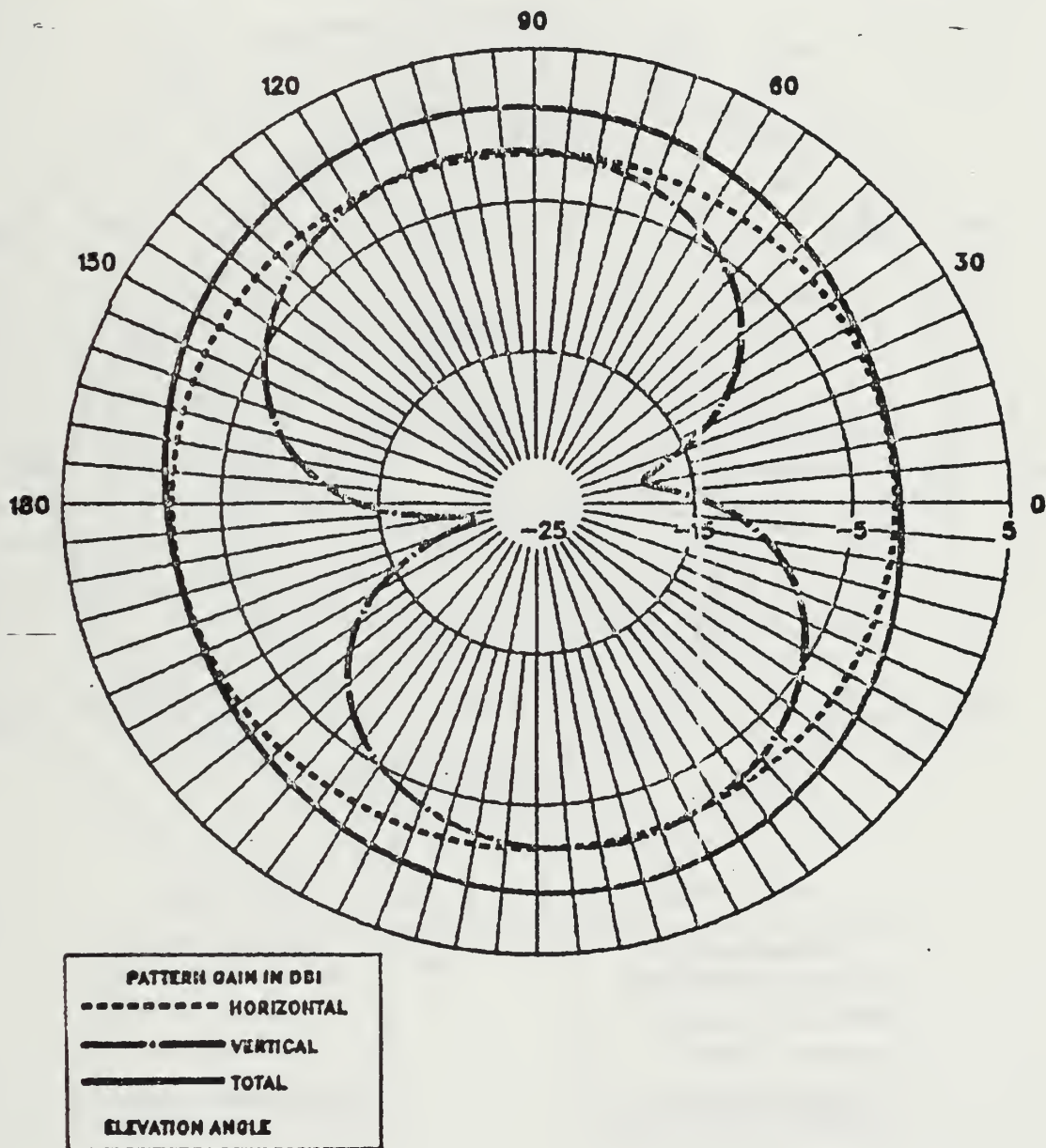
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, $\Phi=0$



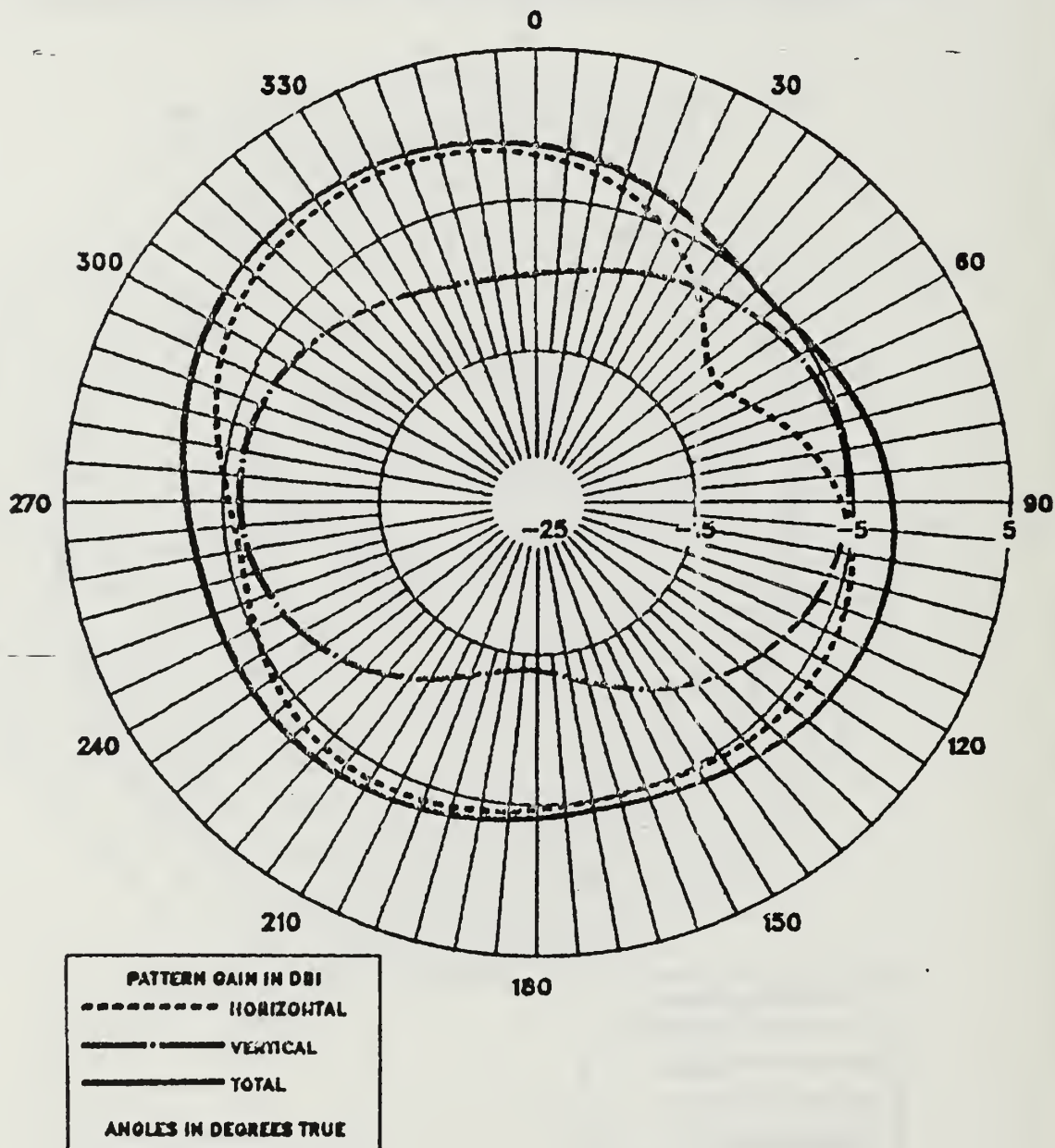
H60 IGUANA DATA RUN AT 5.696MHZ ON 8/20/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



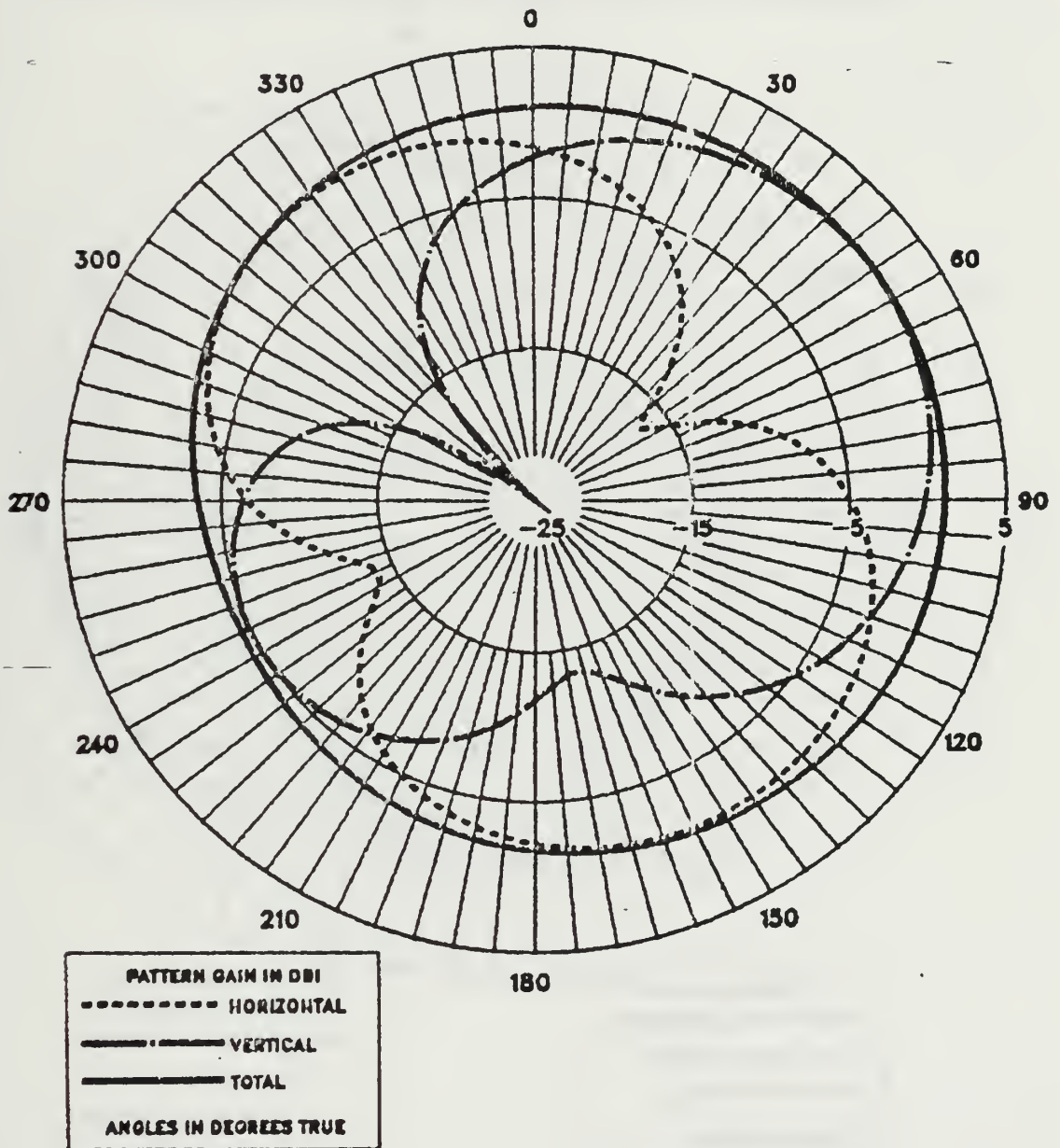
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26

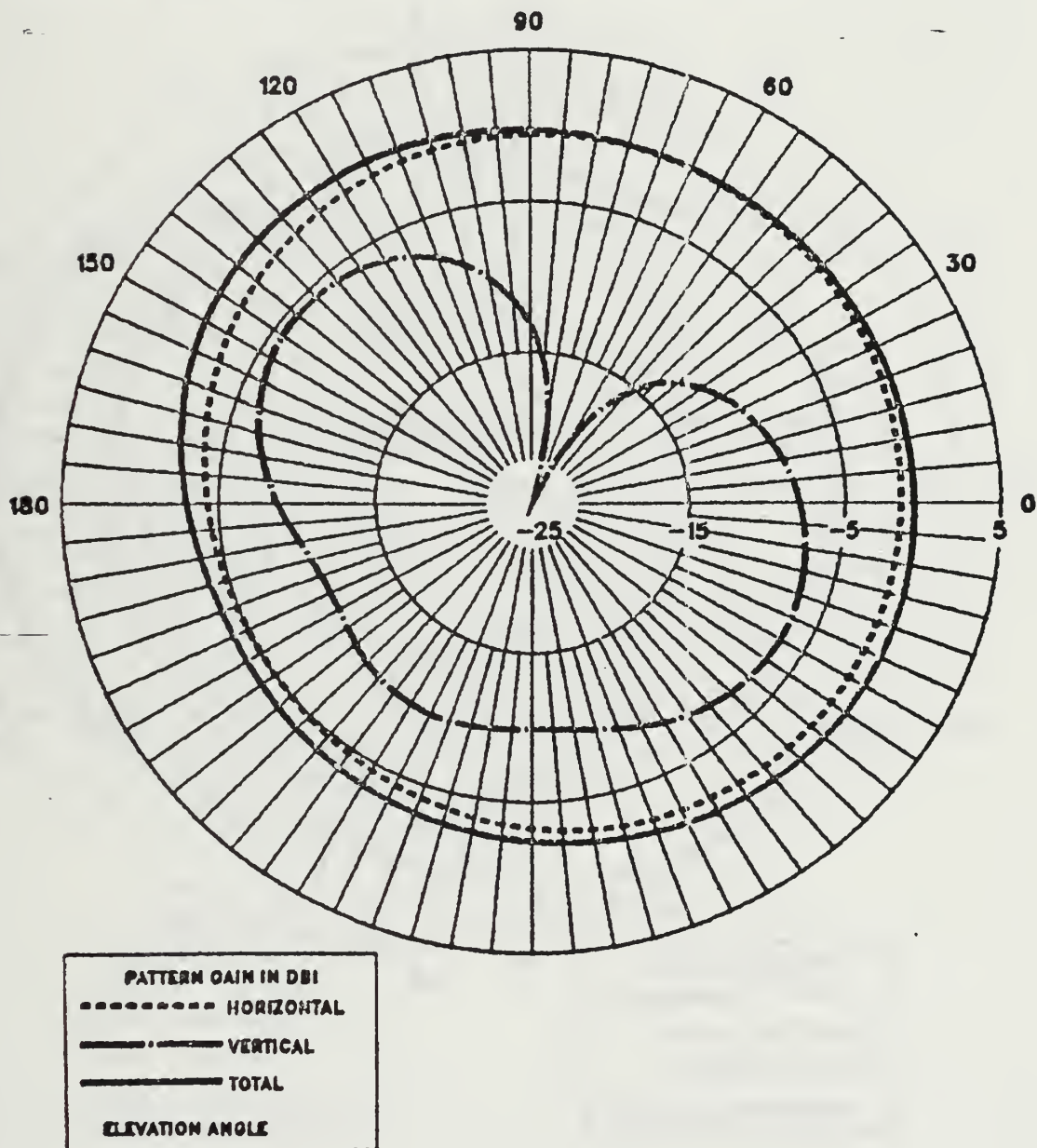


LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



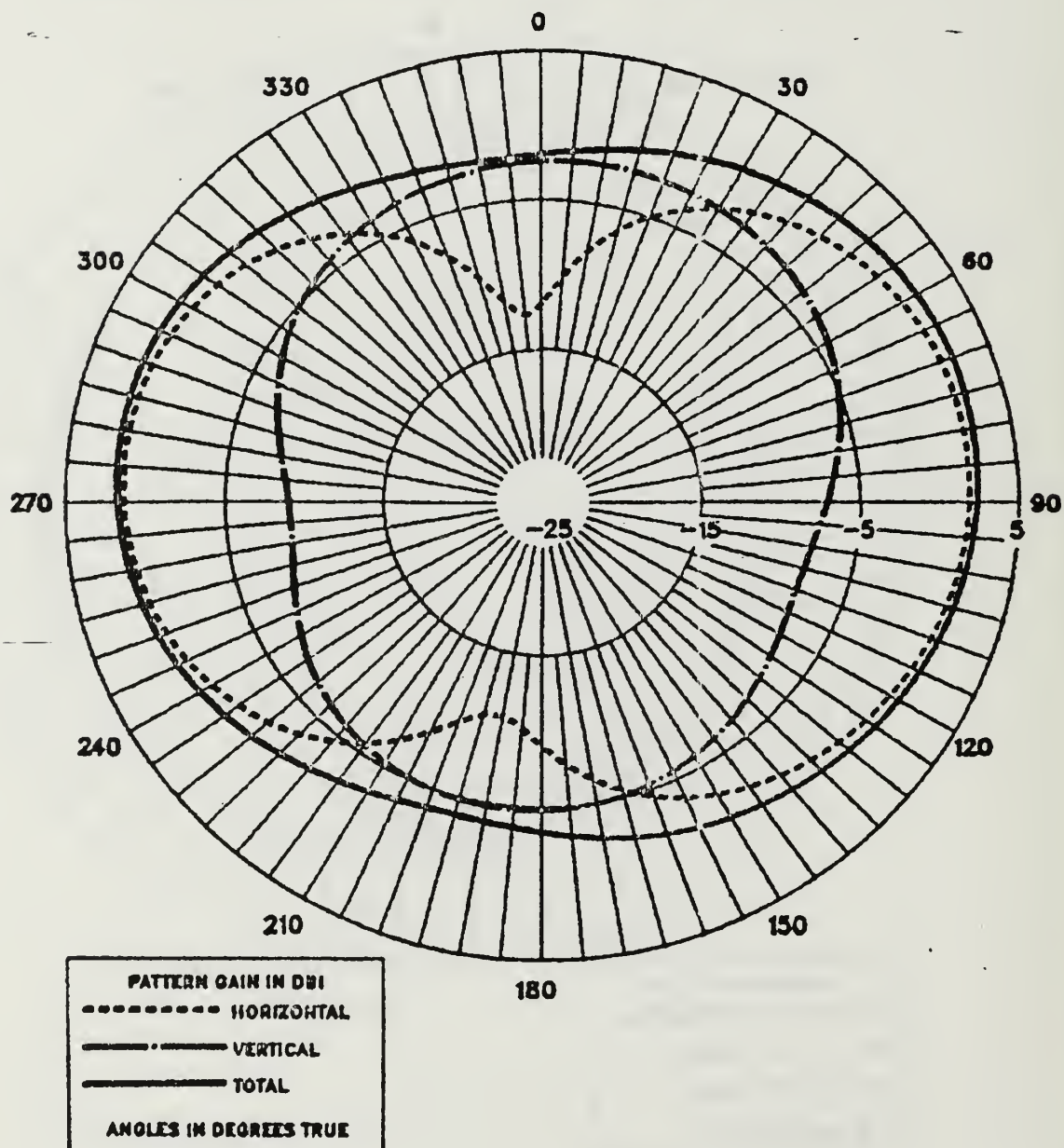
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



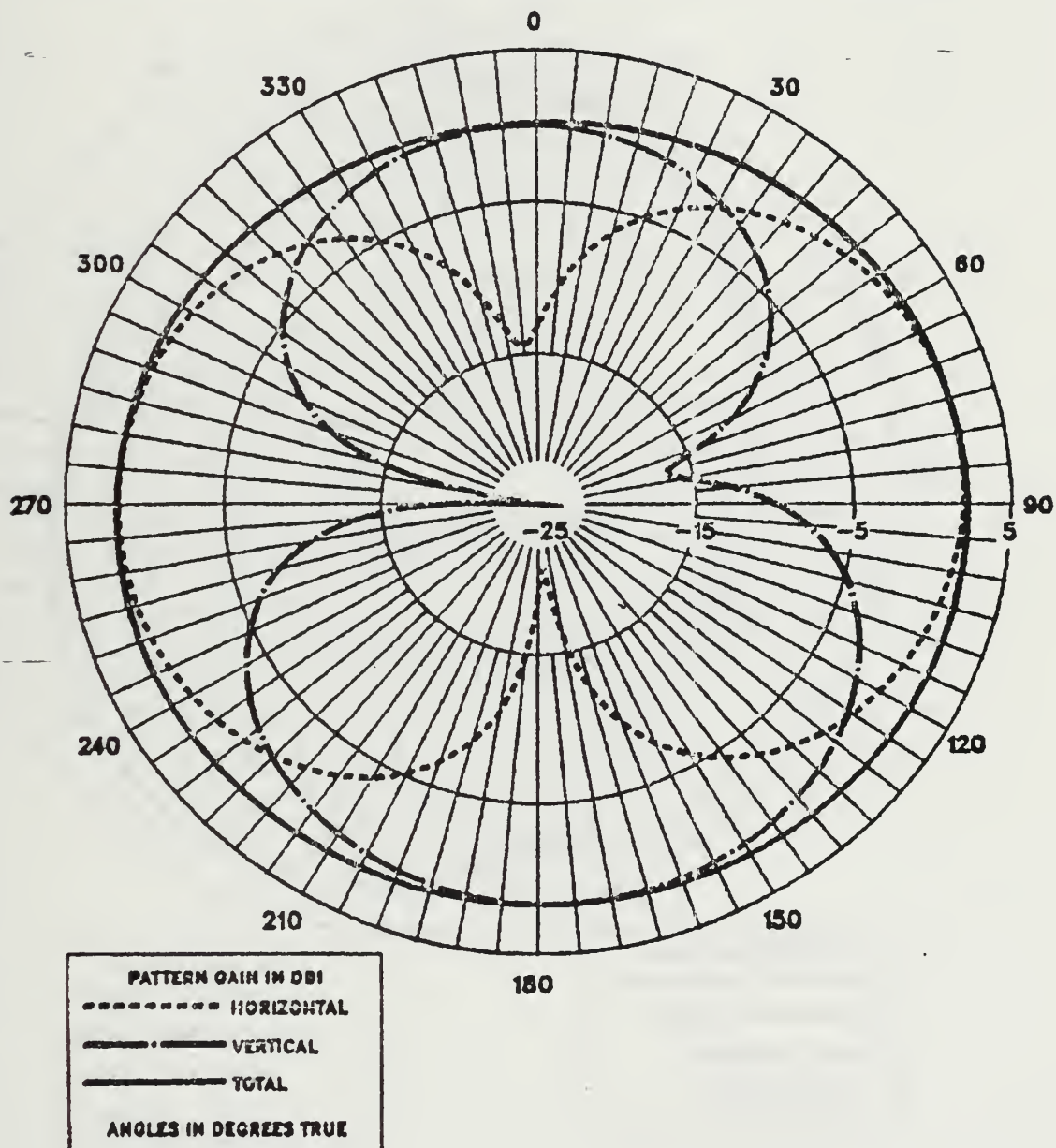
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NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



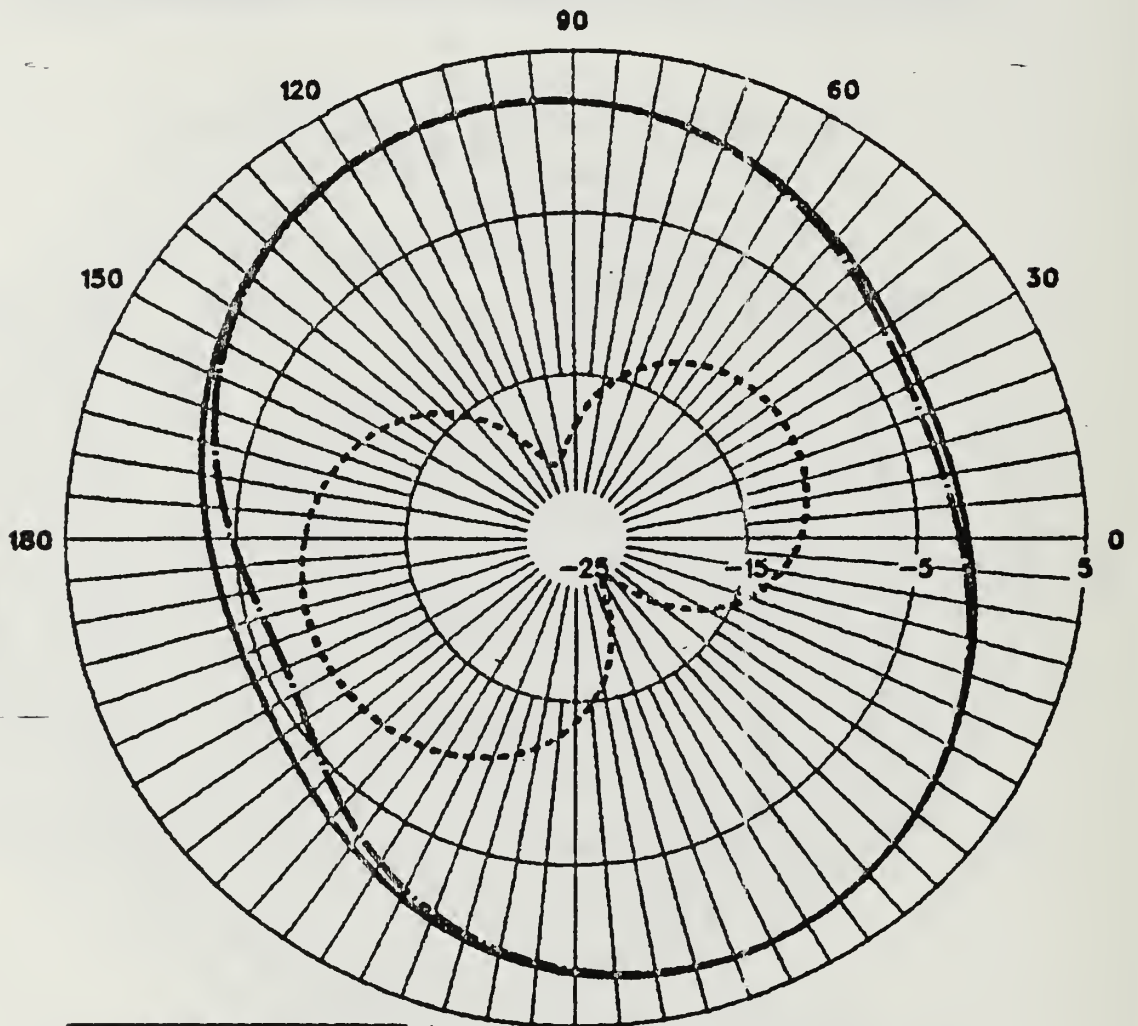
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



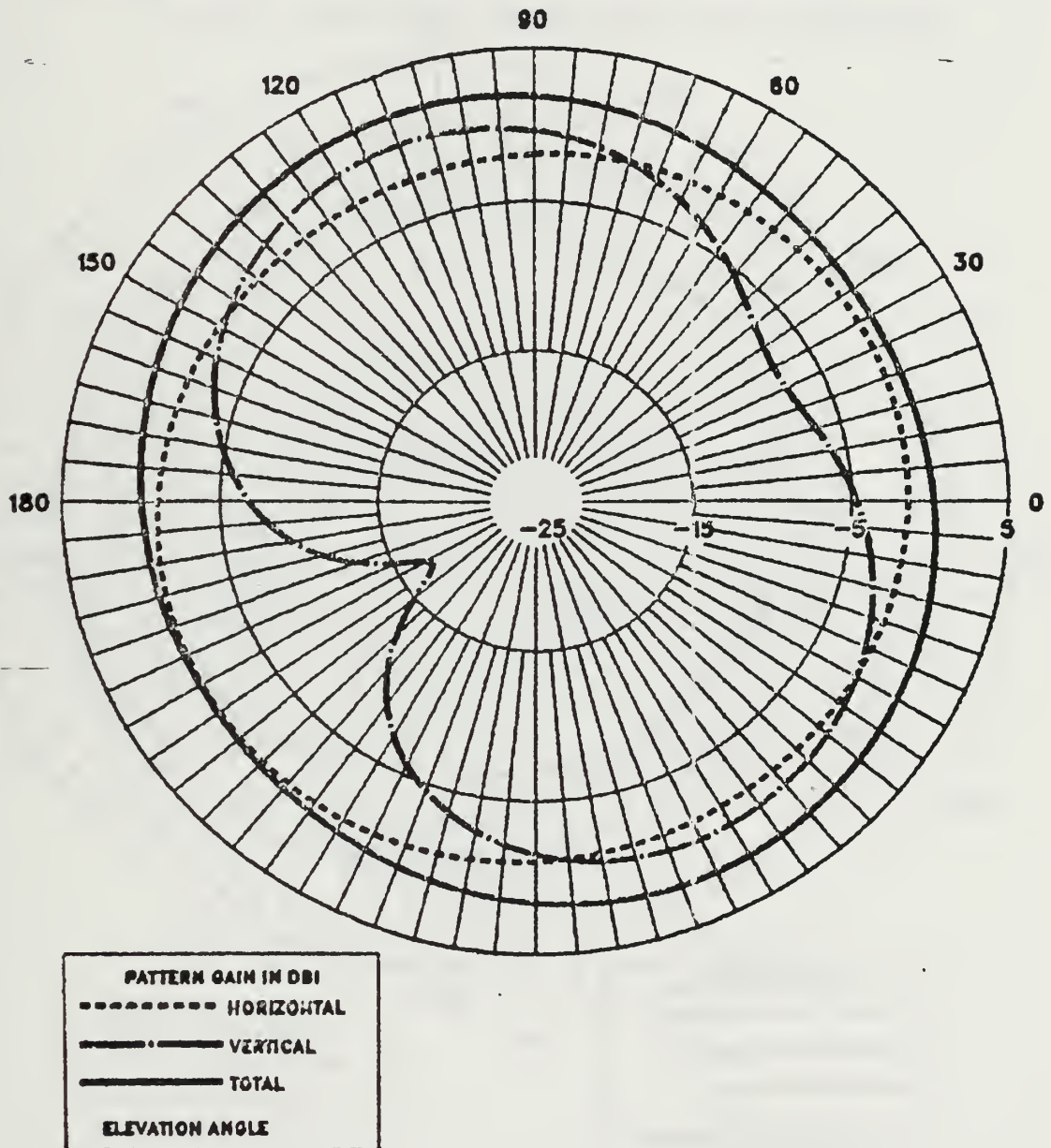
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



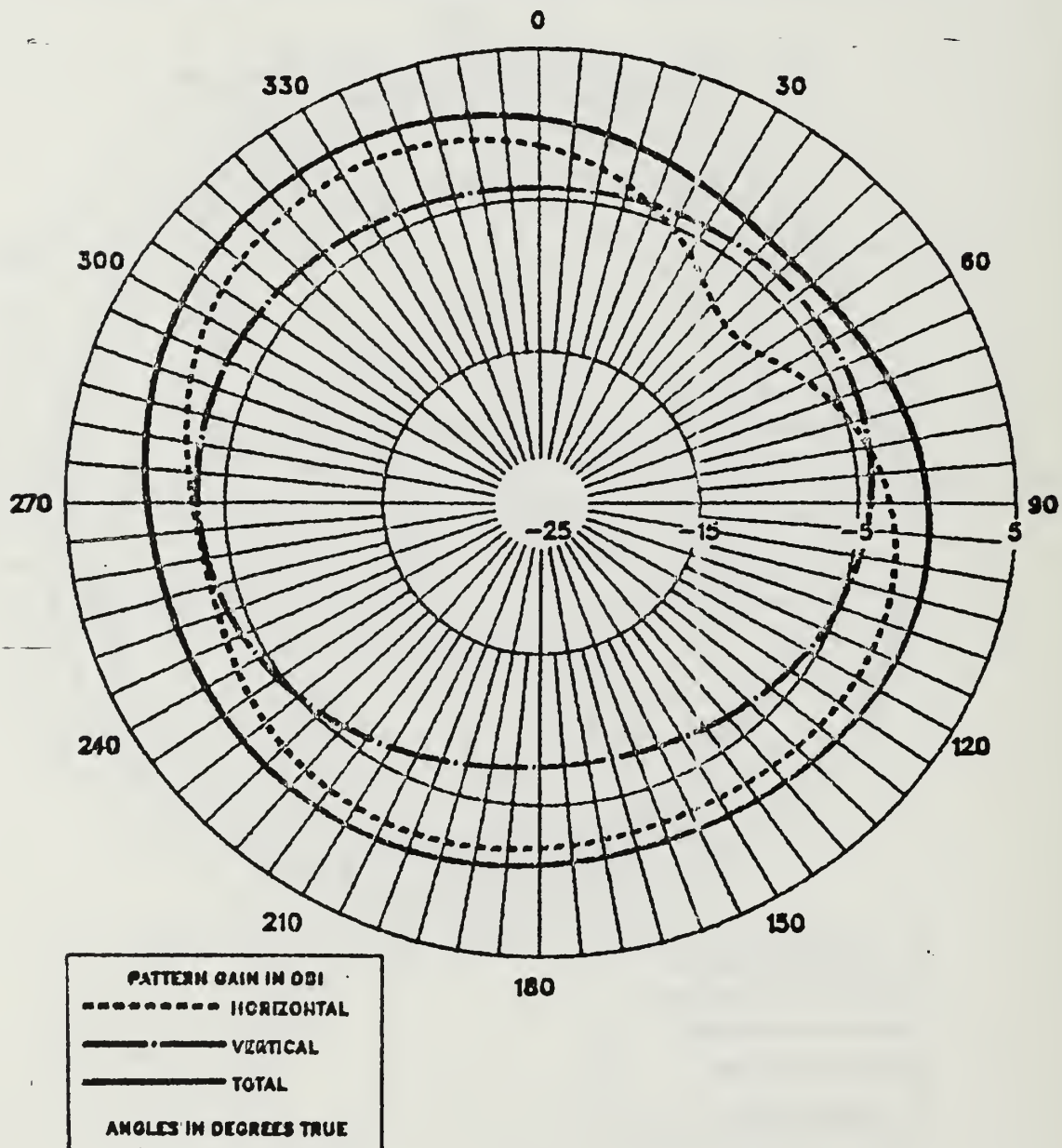
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



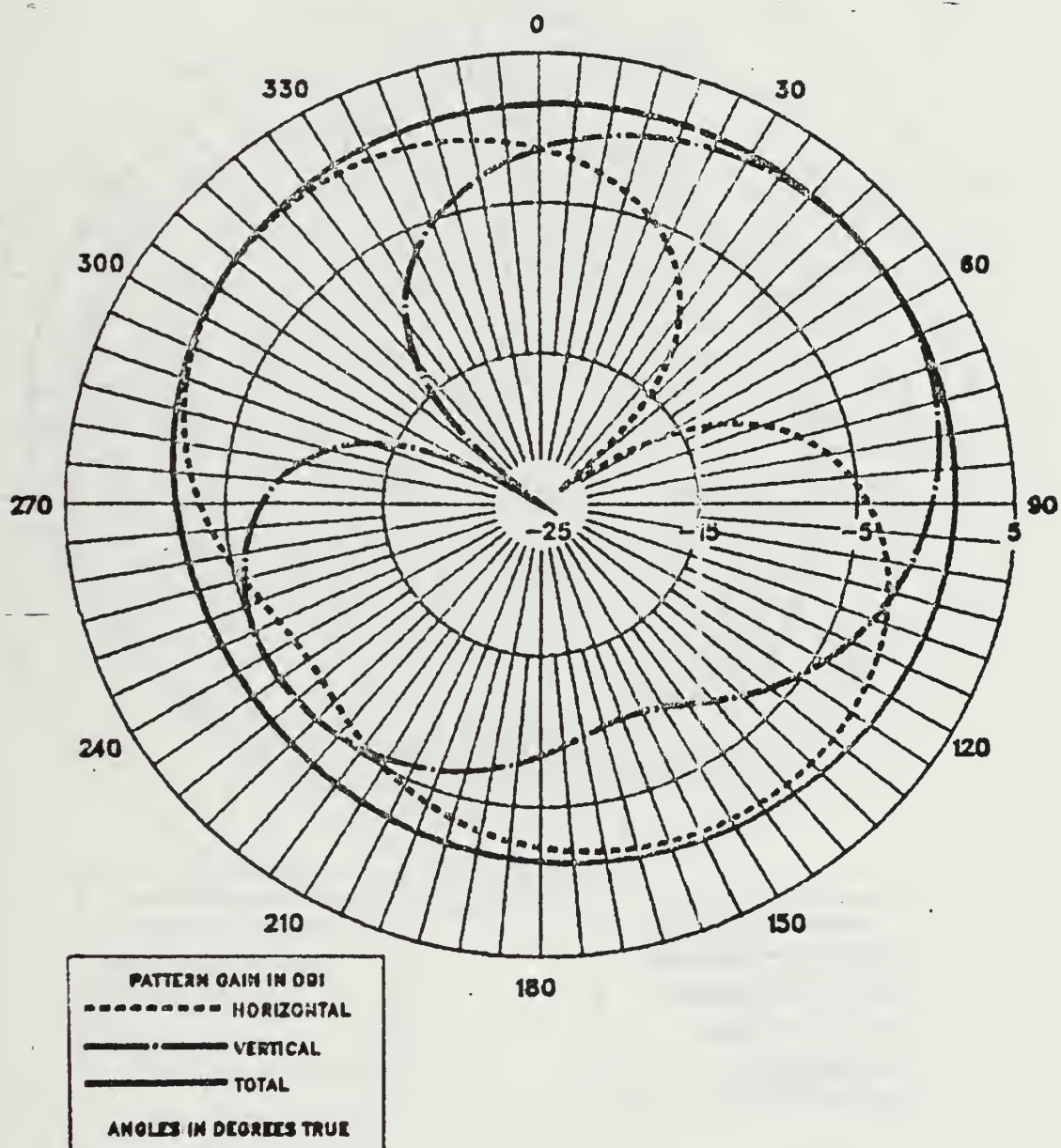
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



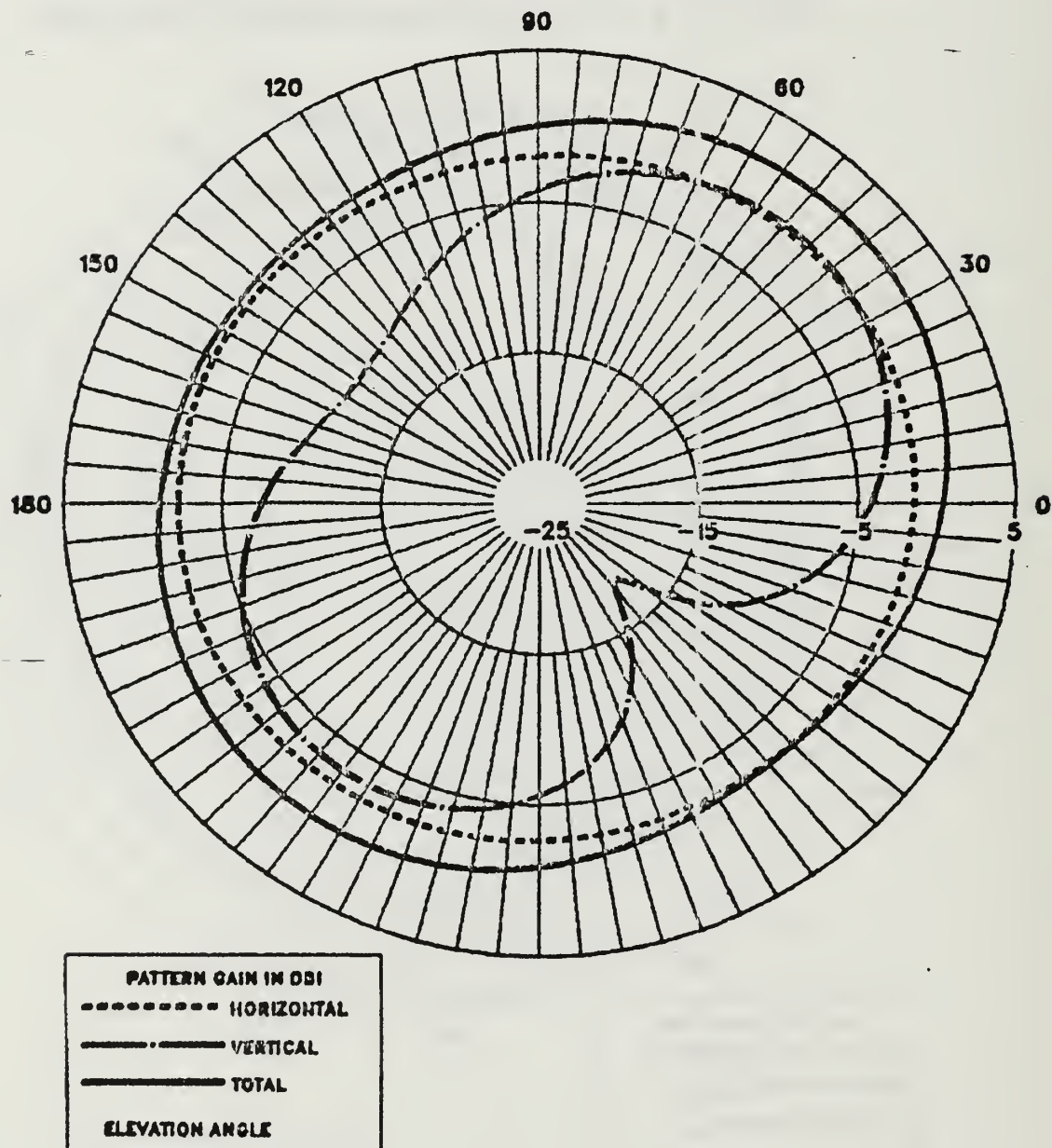
H60 IGUANA DATA RUN AT 7.645MHZ ON 8/21/87

CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



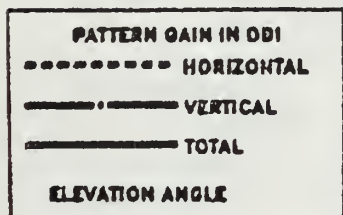
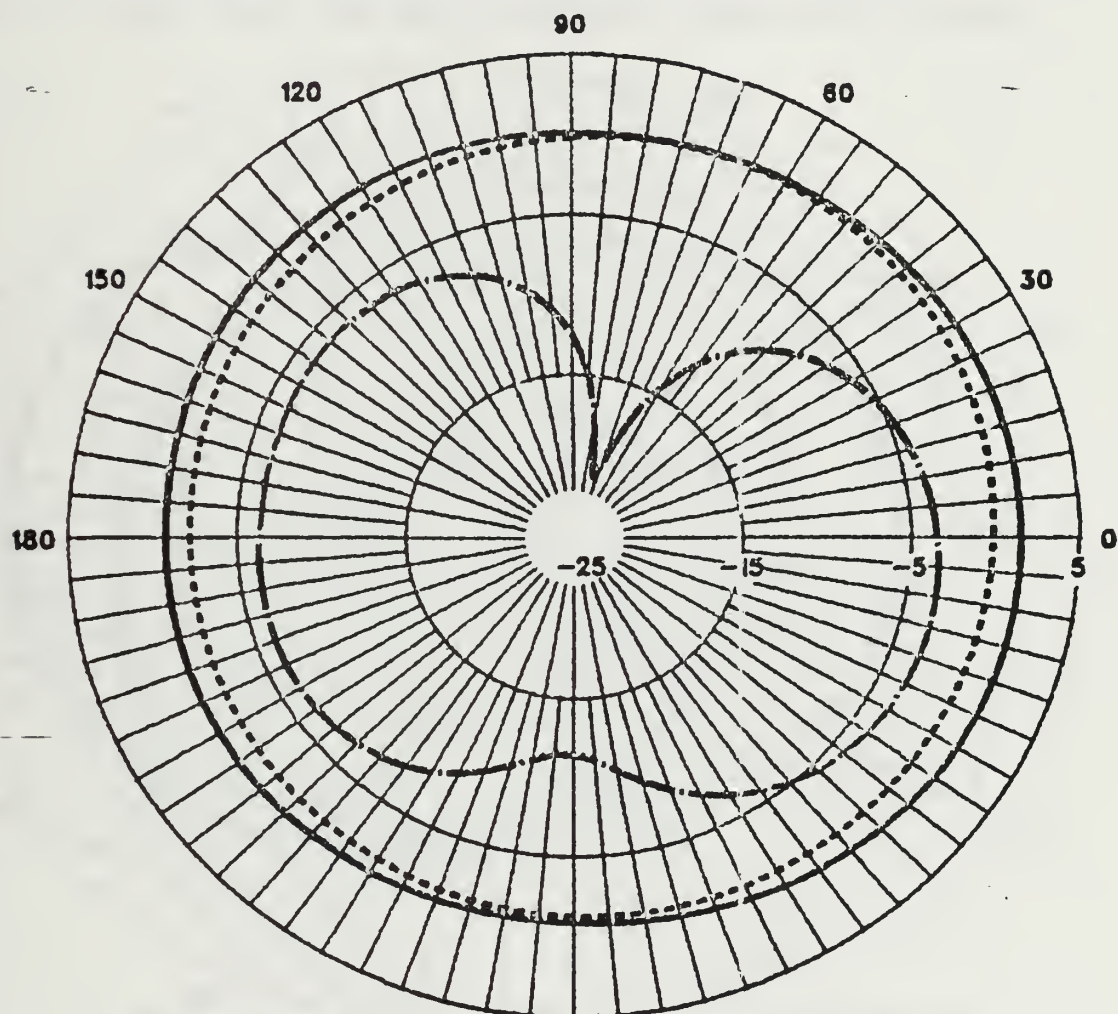
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



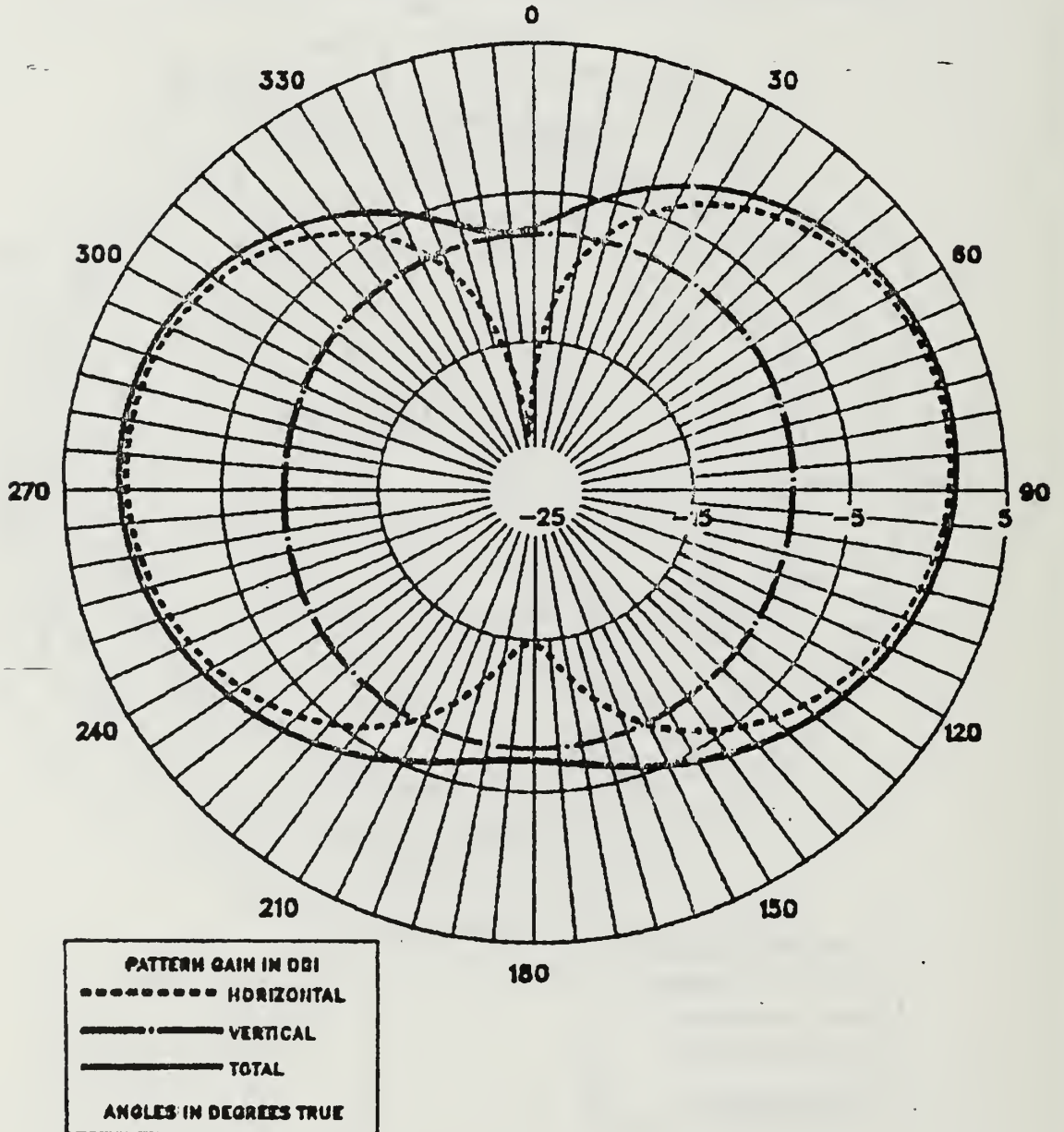
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



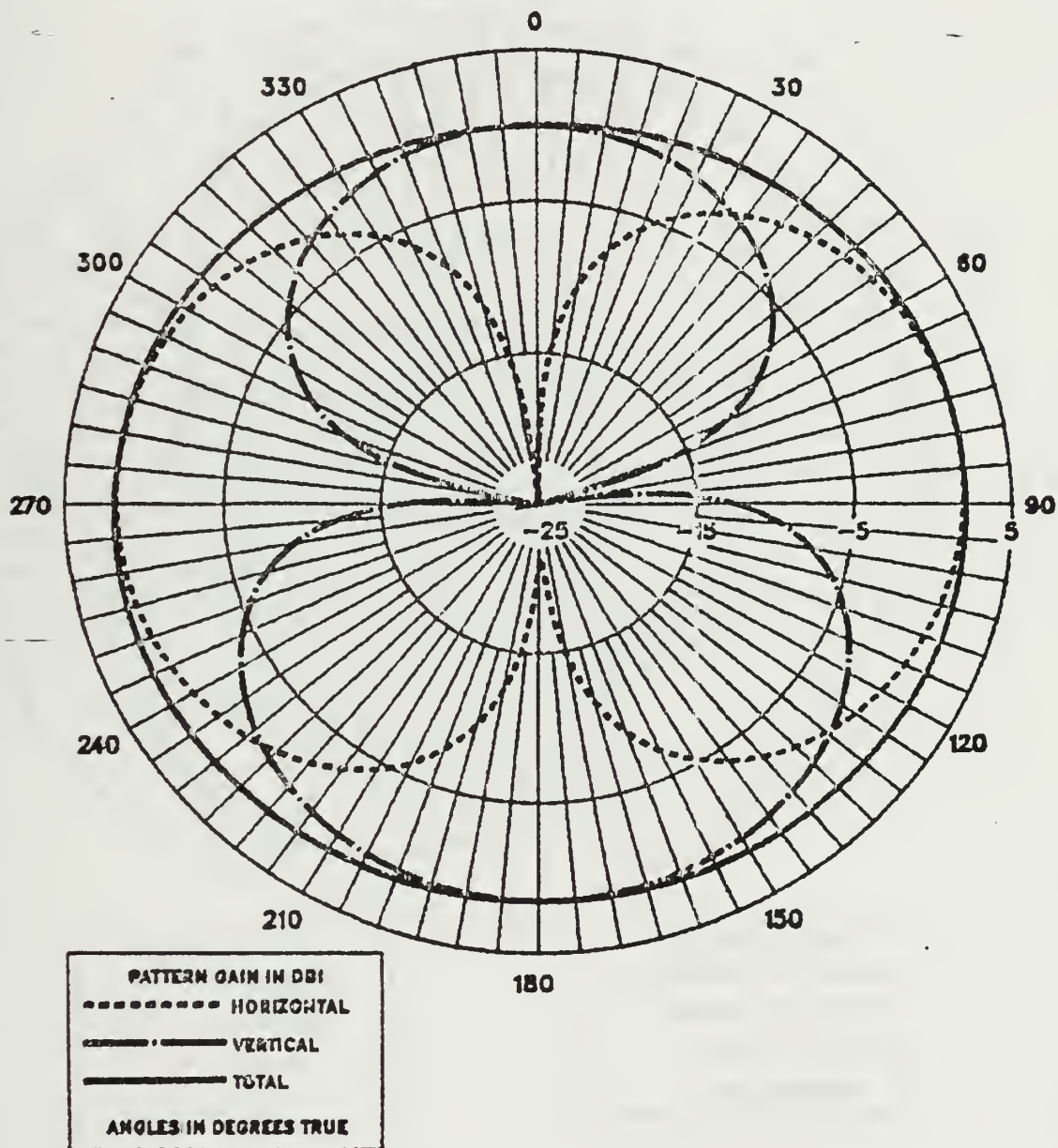
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



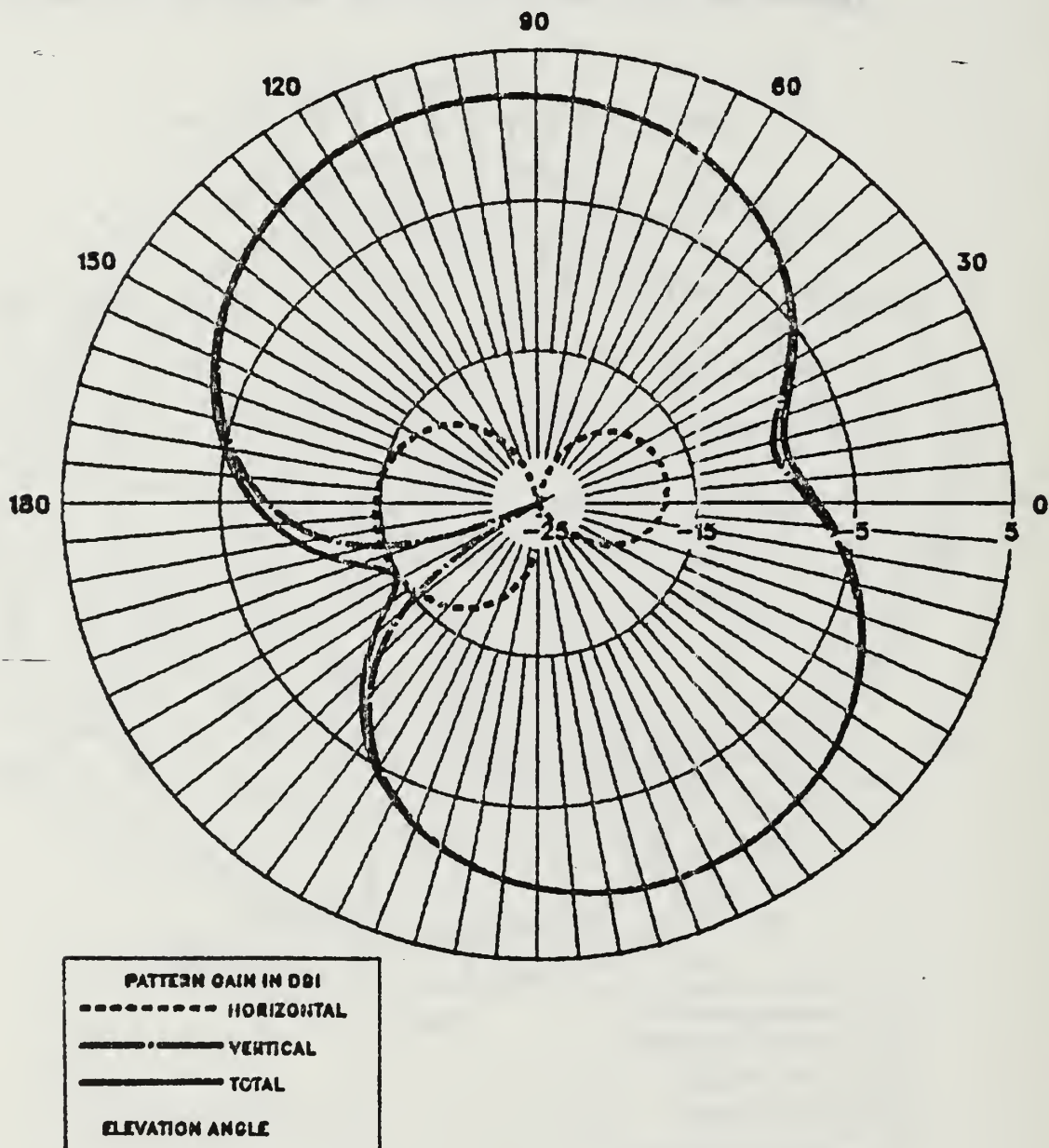
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



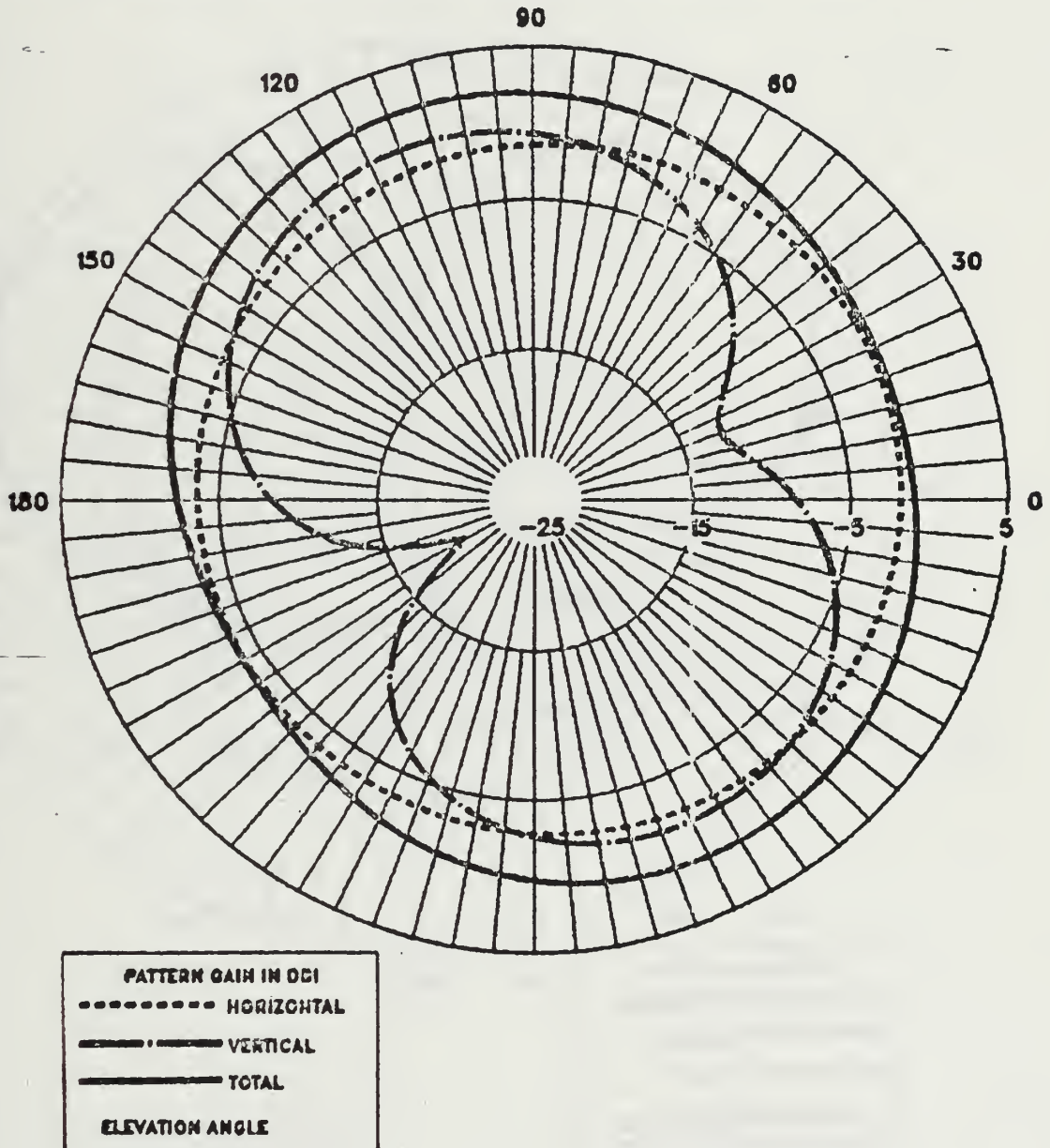
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



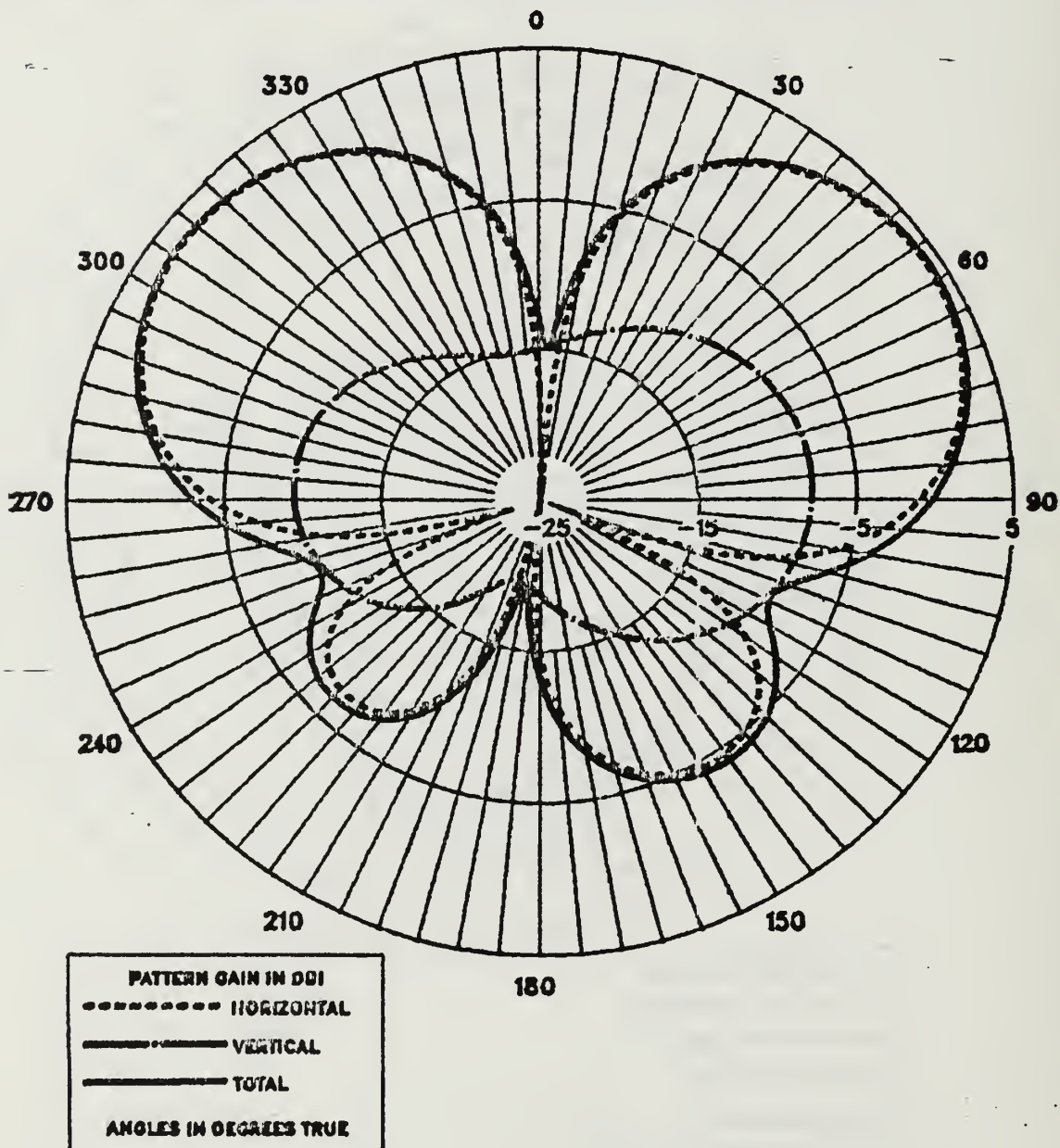
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



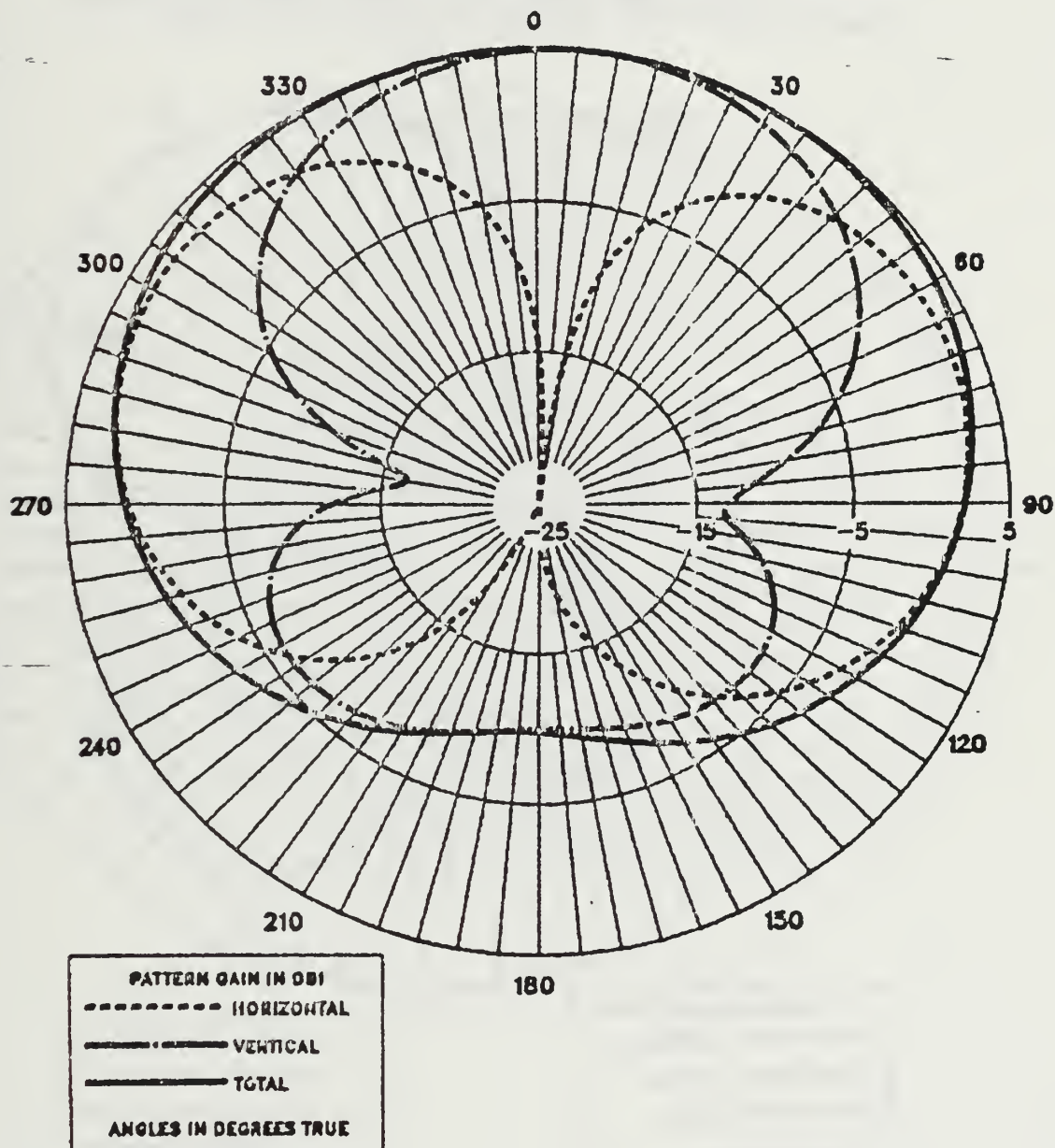
H60 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



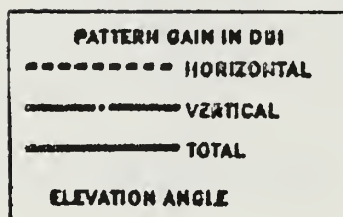
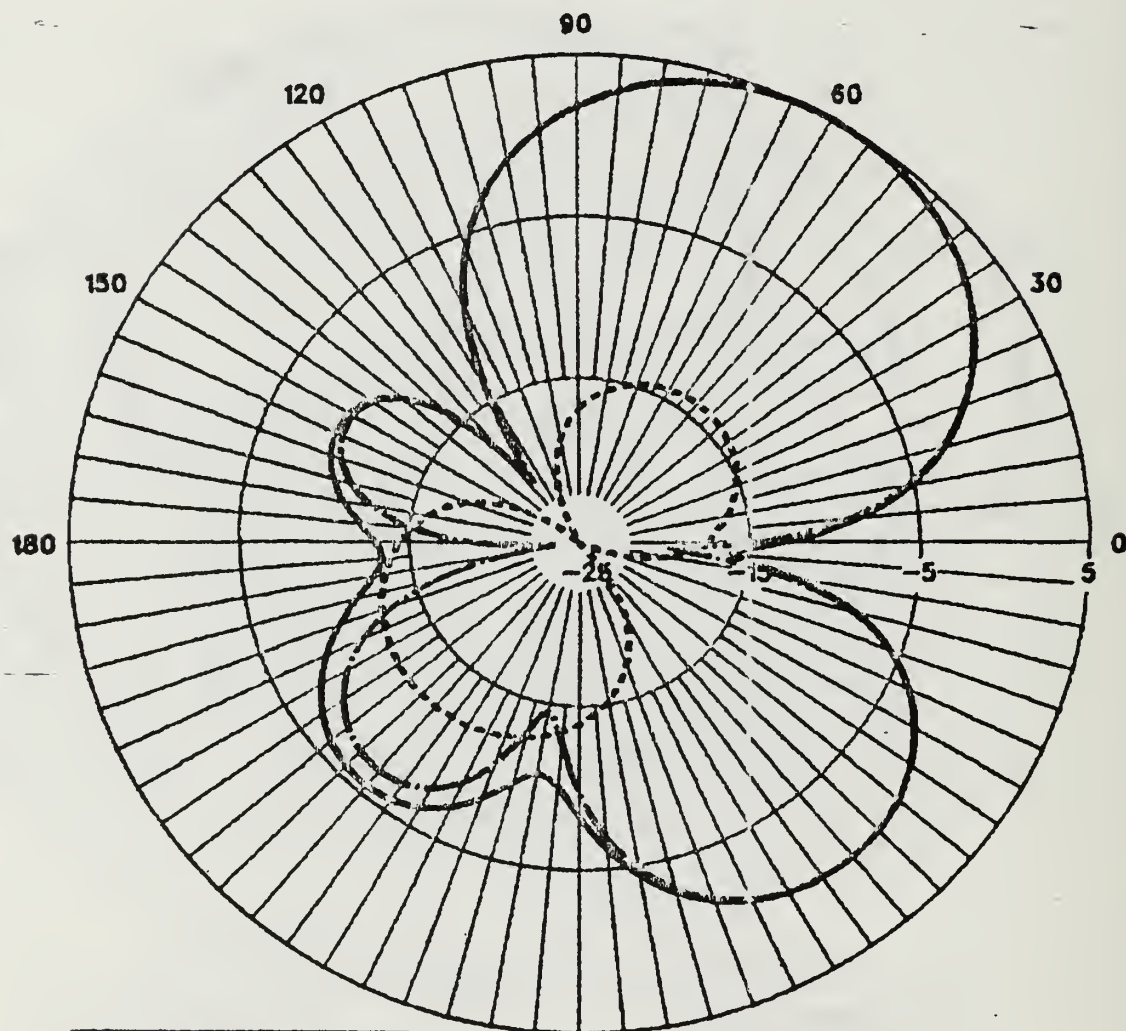
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LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



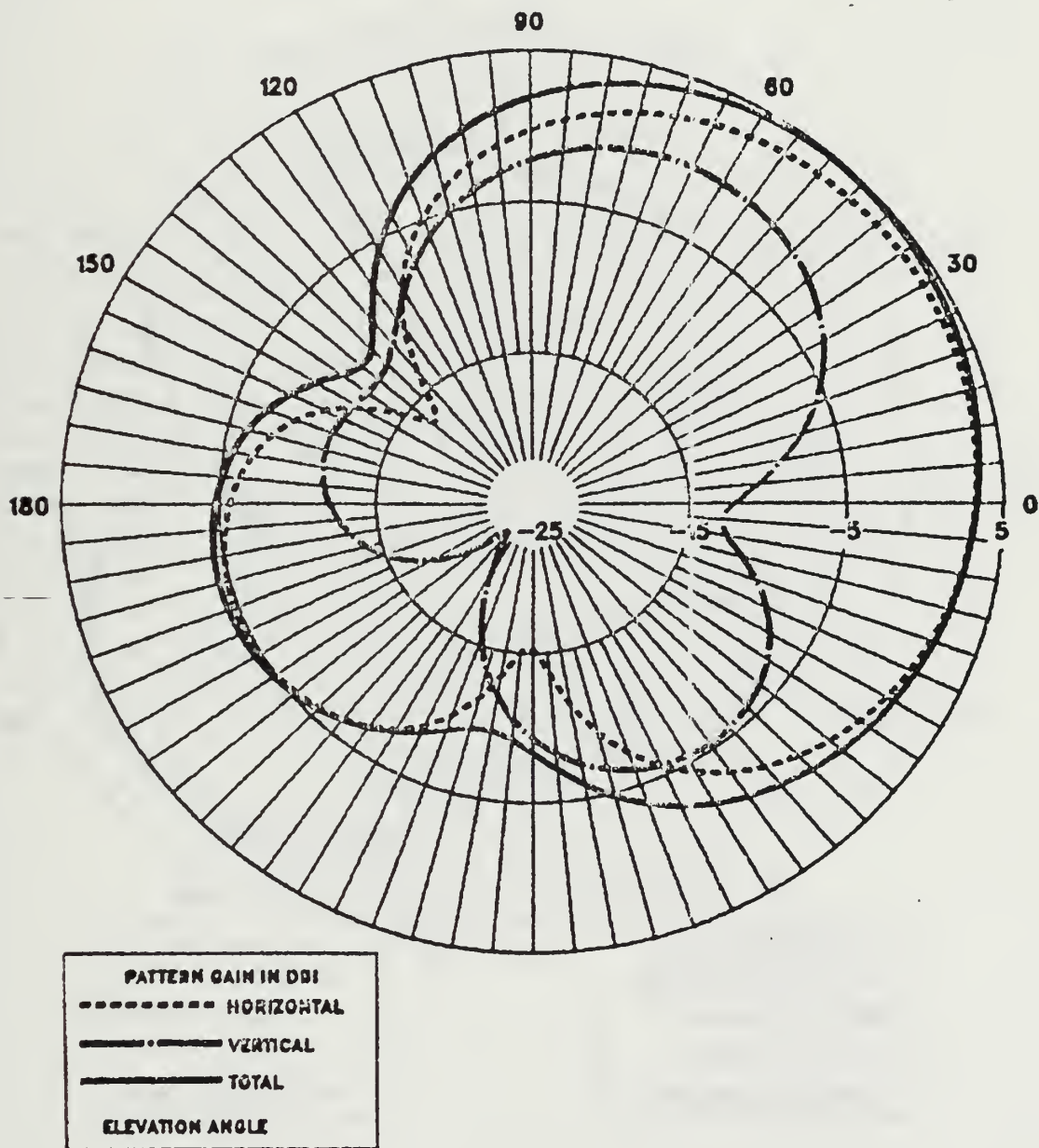
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



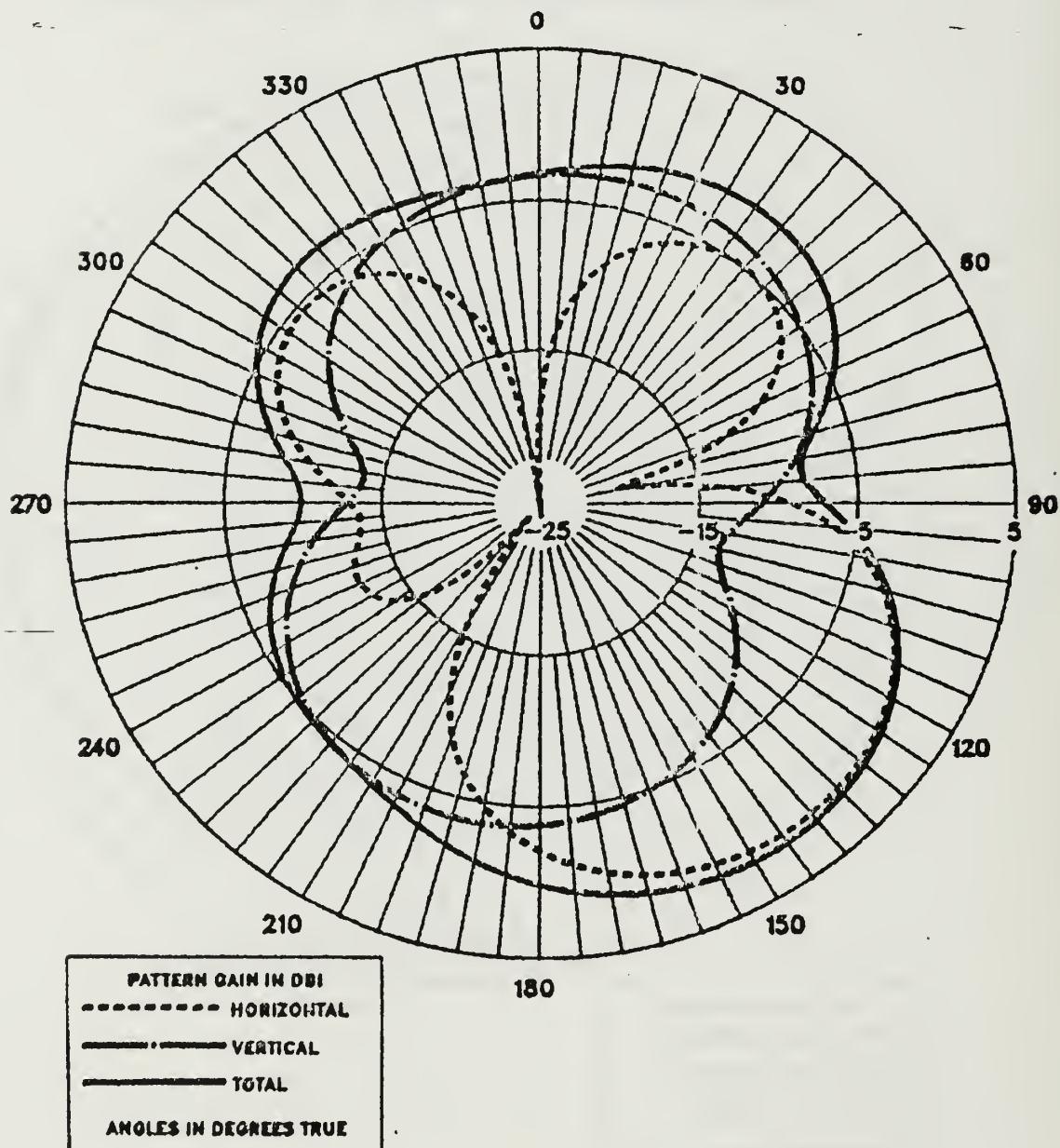
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LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



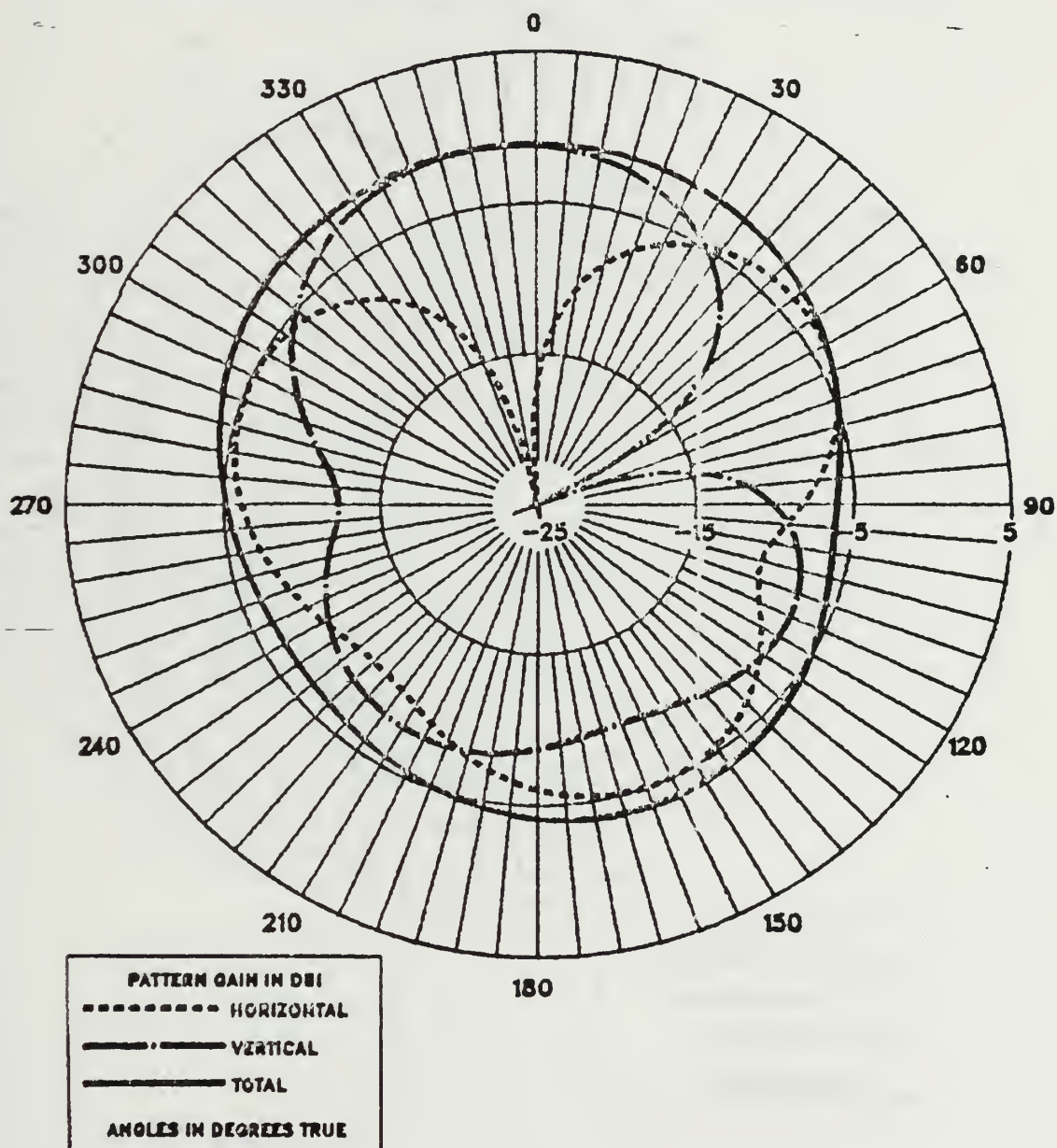
H60 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



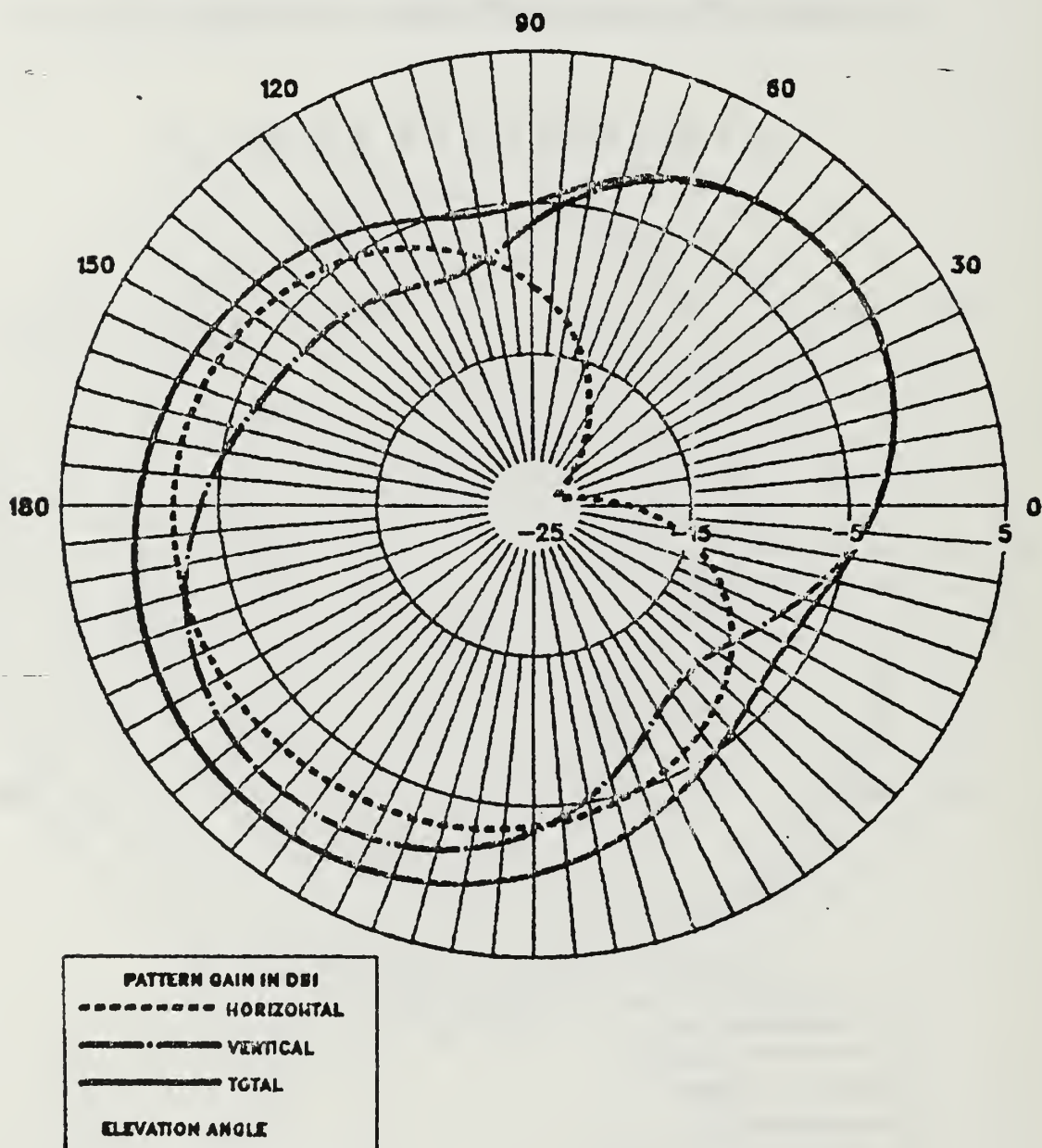
H60 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



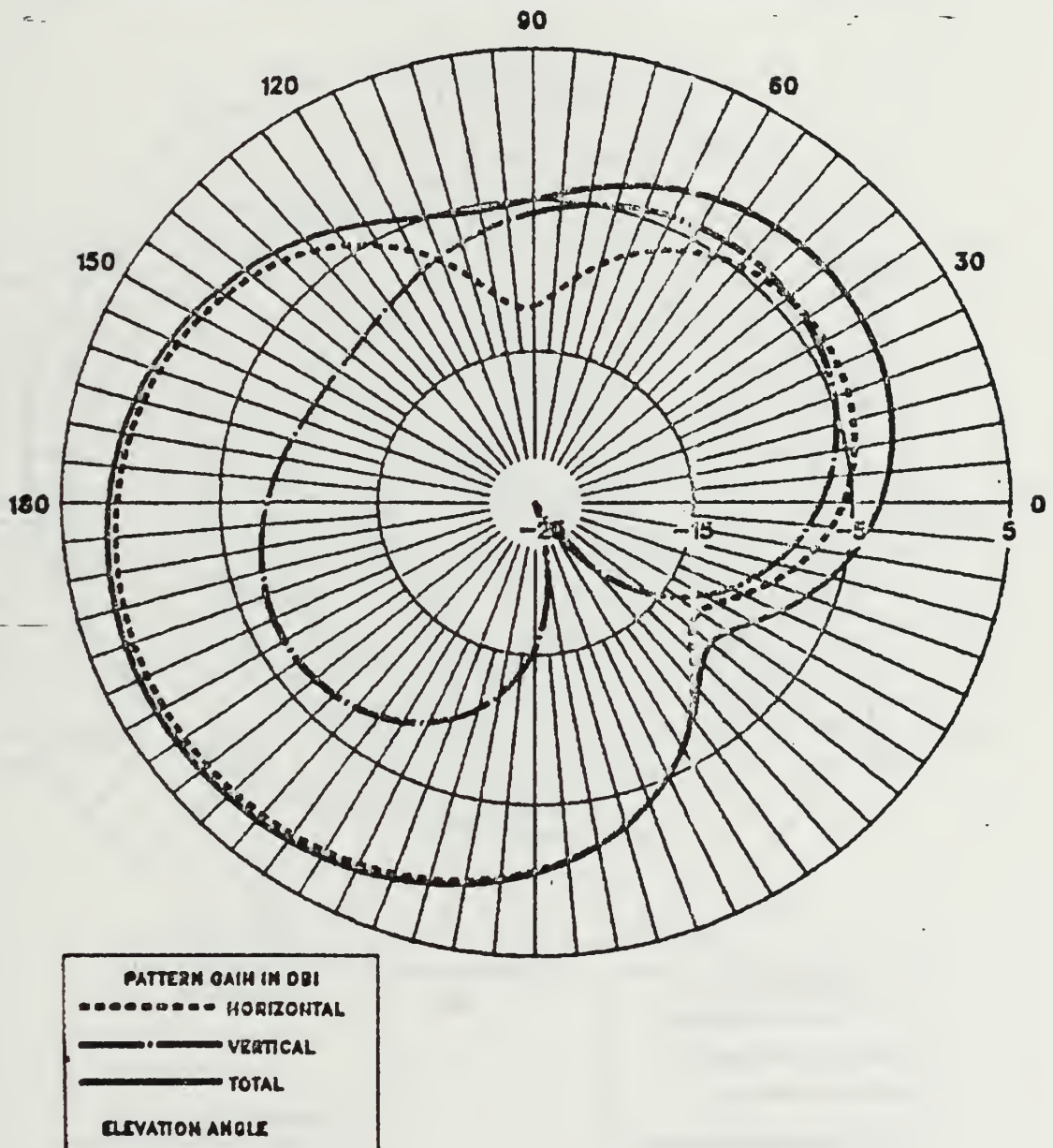
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NAVY 437R-2 ANT, FREE SPACE, VERT CUT, $\Phi=0$



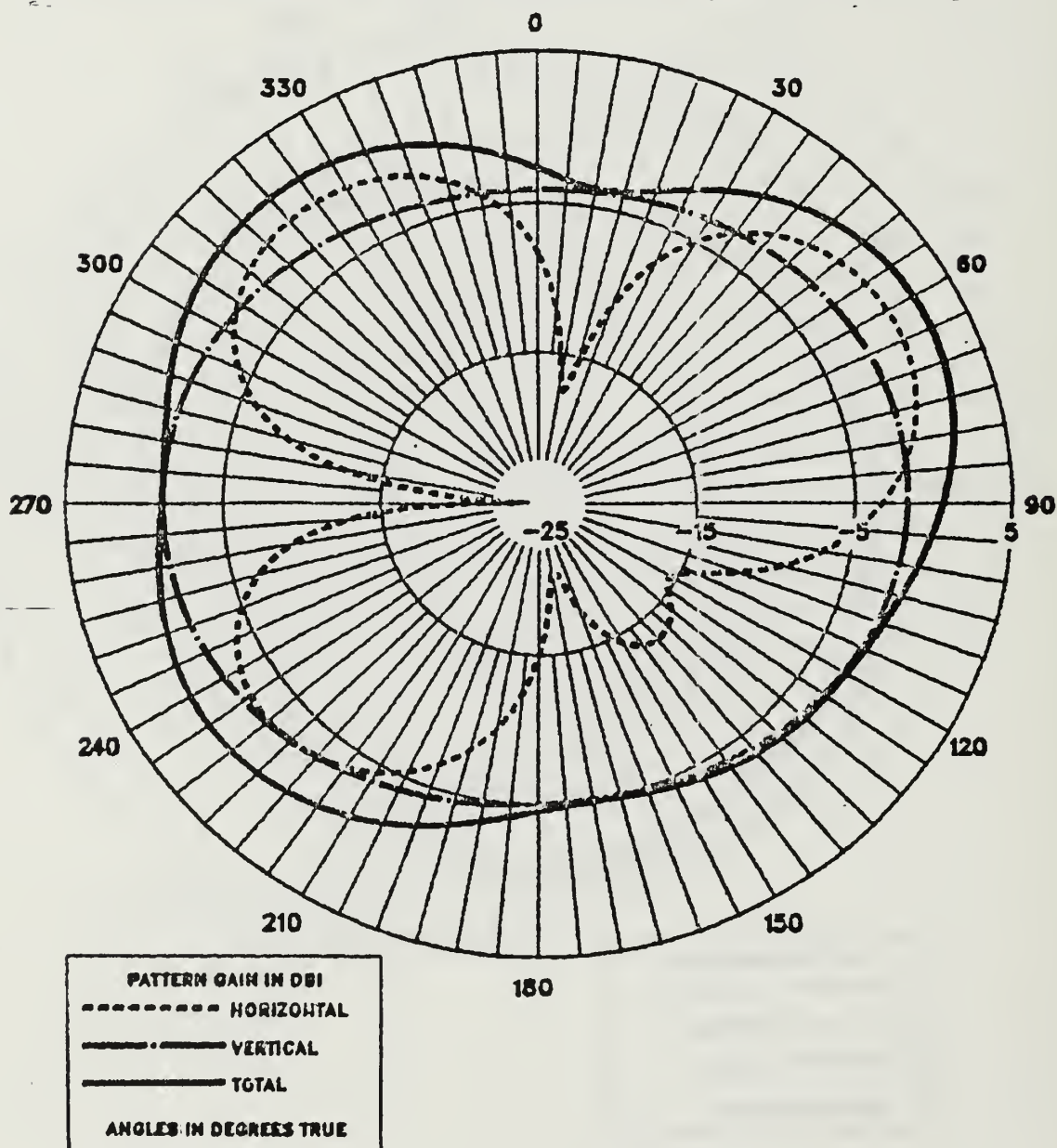
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NAVY 437R-2 ANT, FREE SPACE, VEIRT CUT, PHI=45



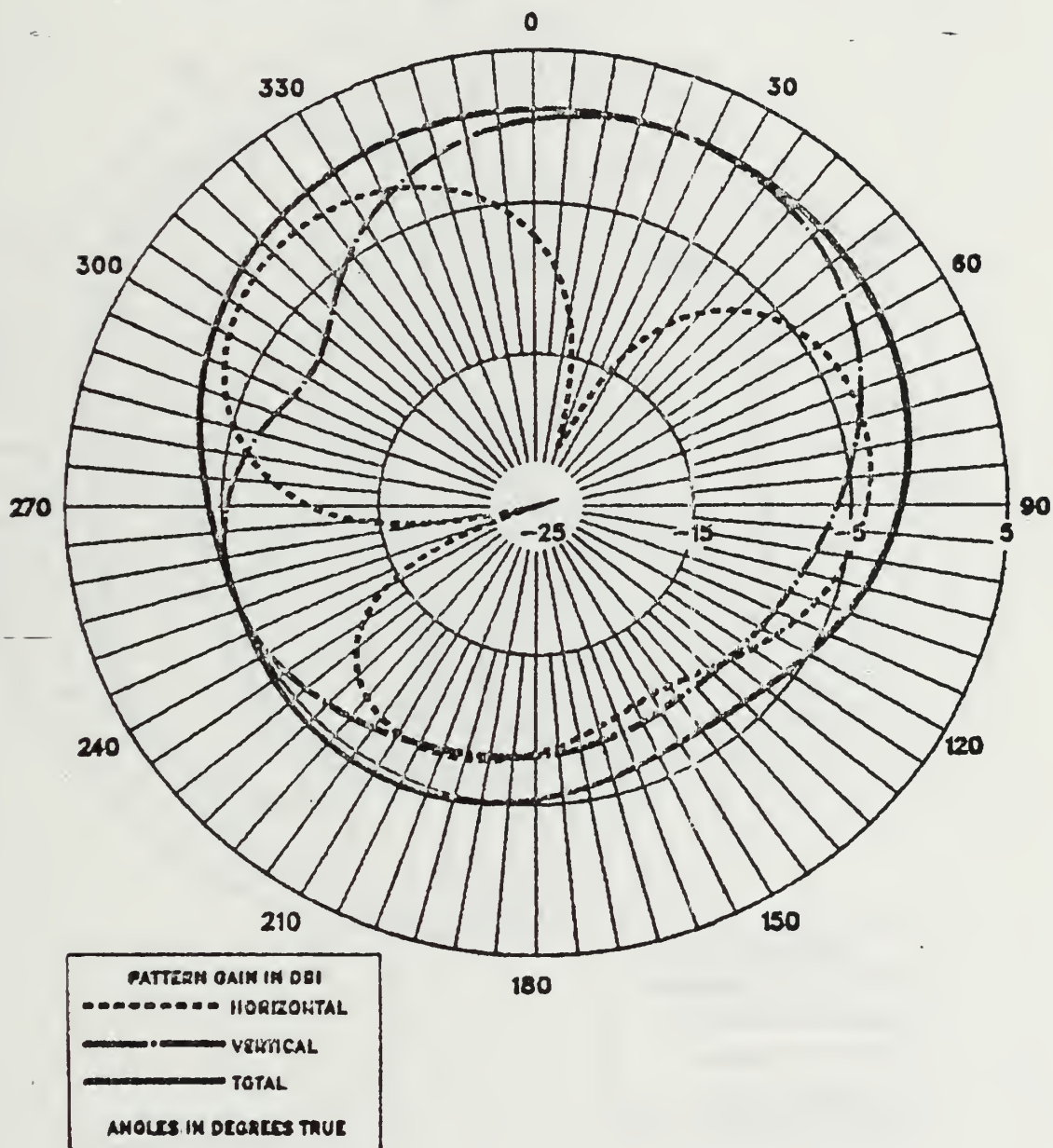
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



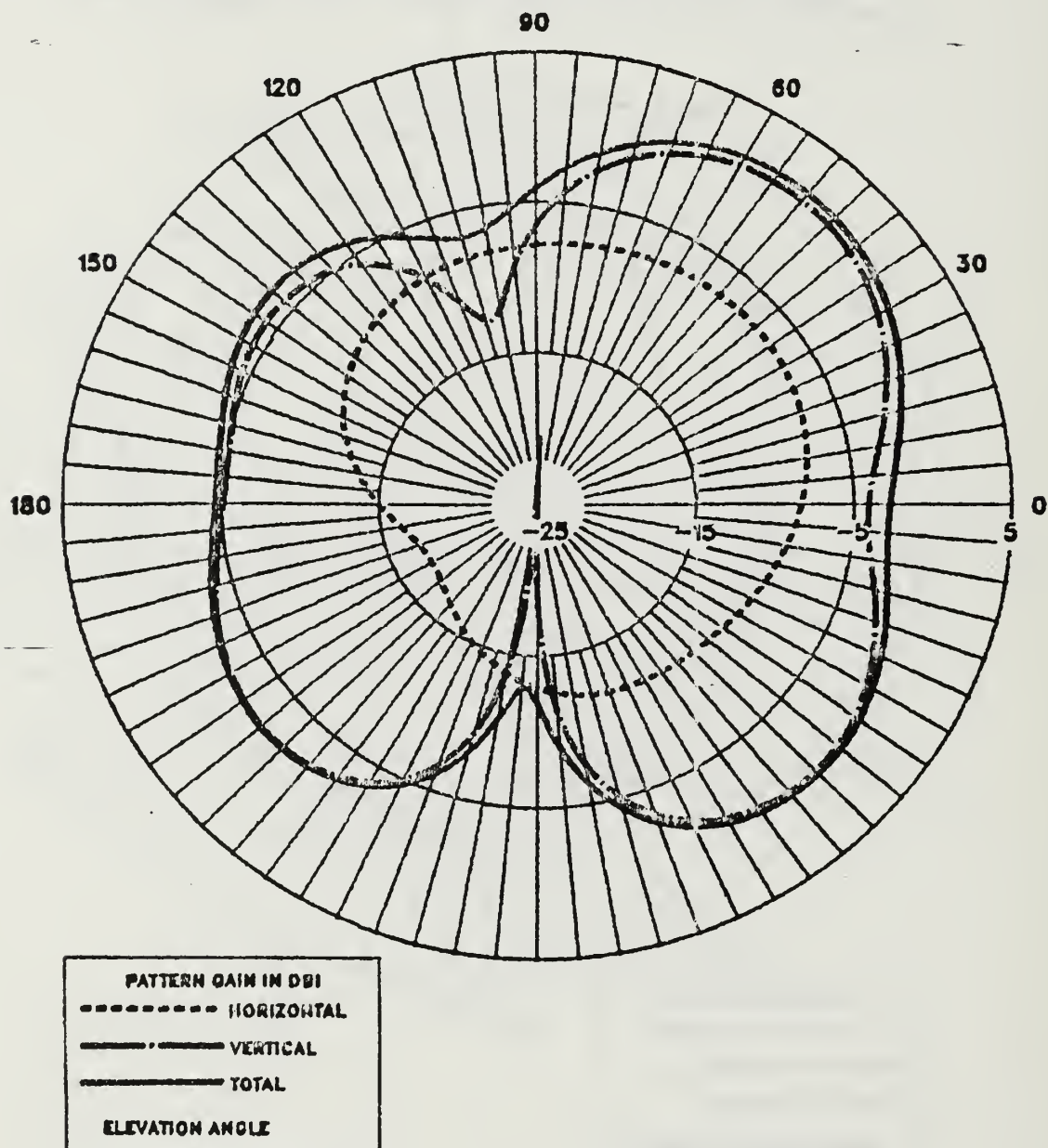
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



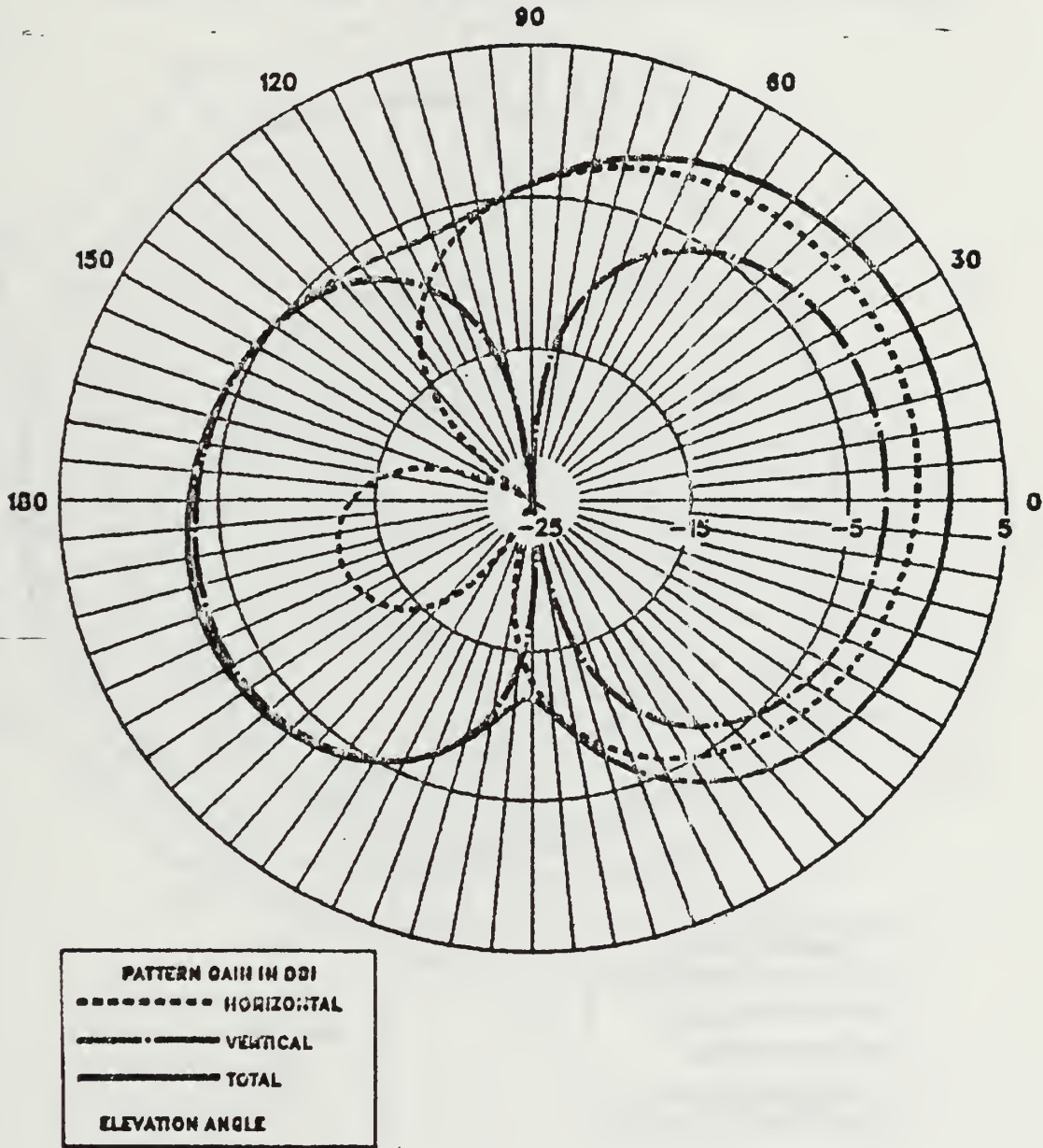
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



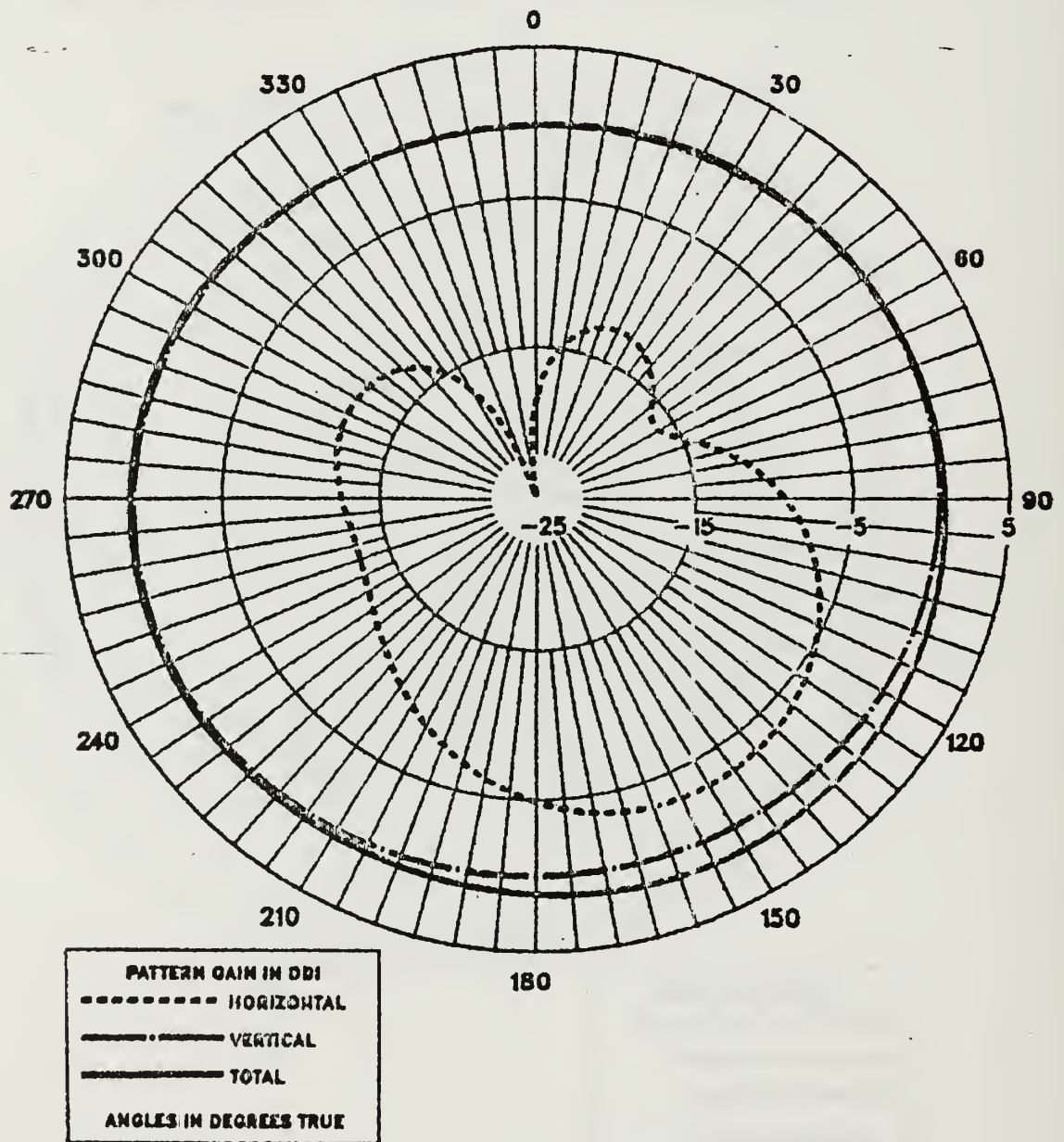
H60 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



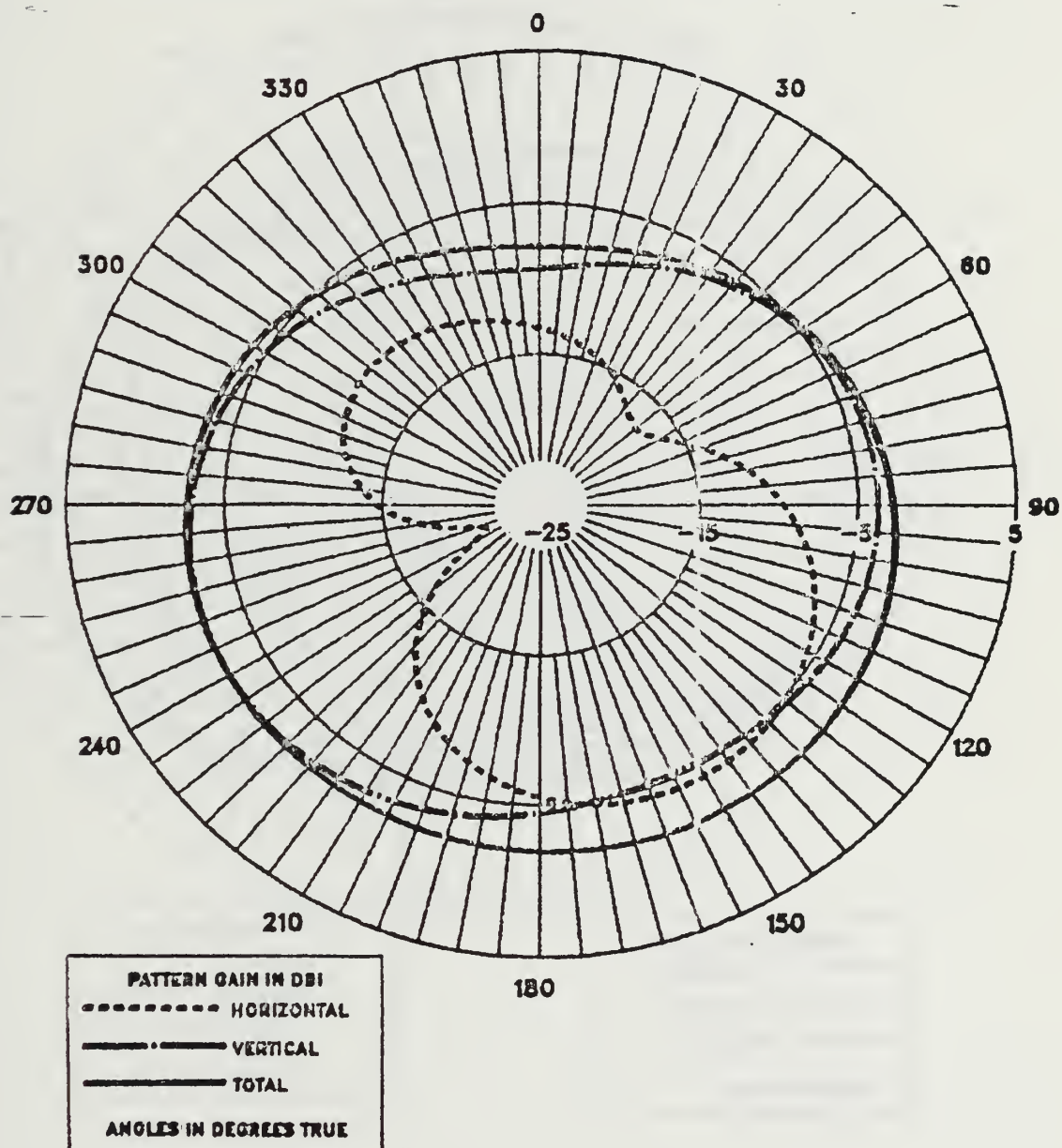
H60 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



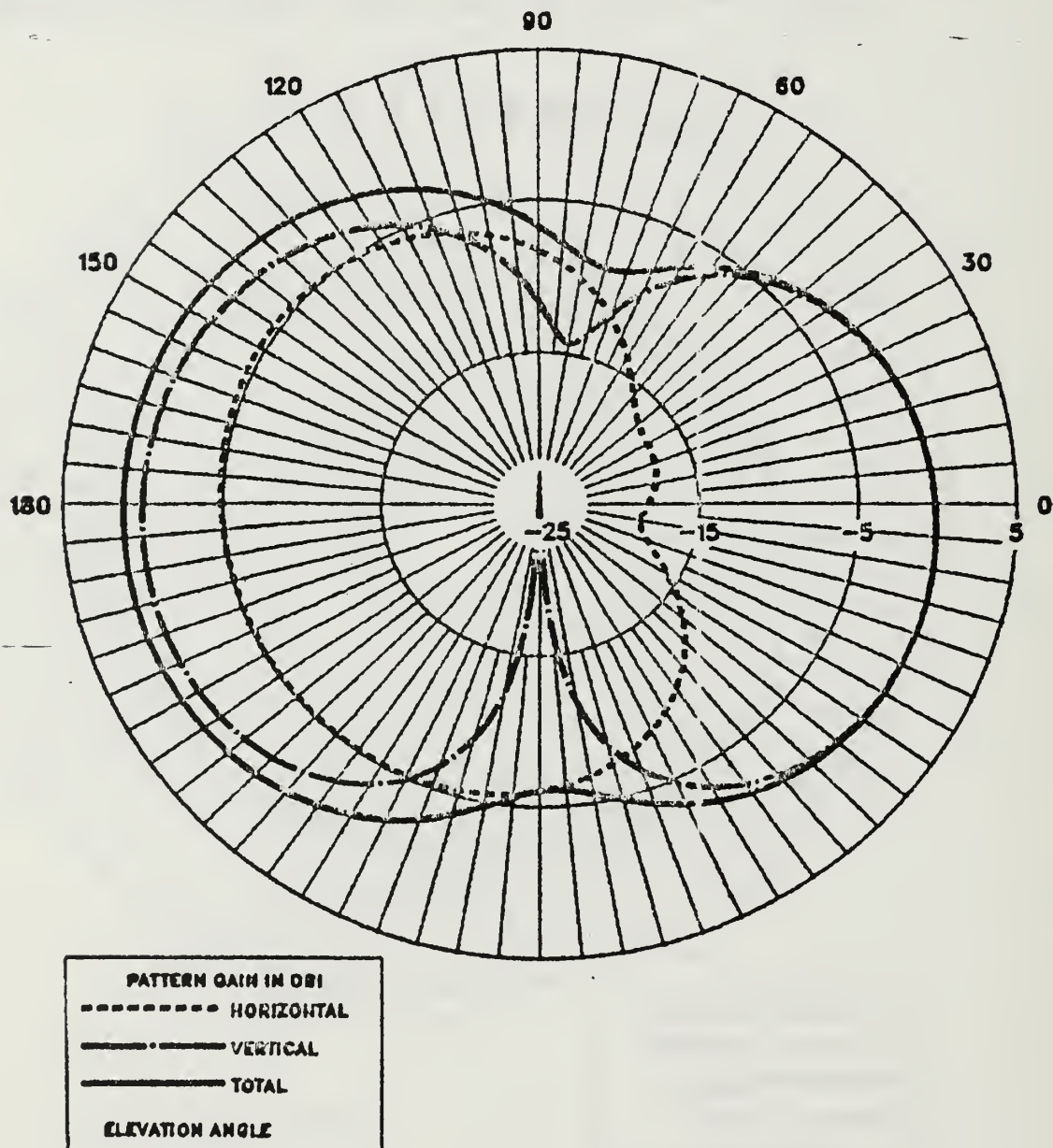
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ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



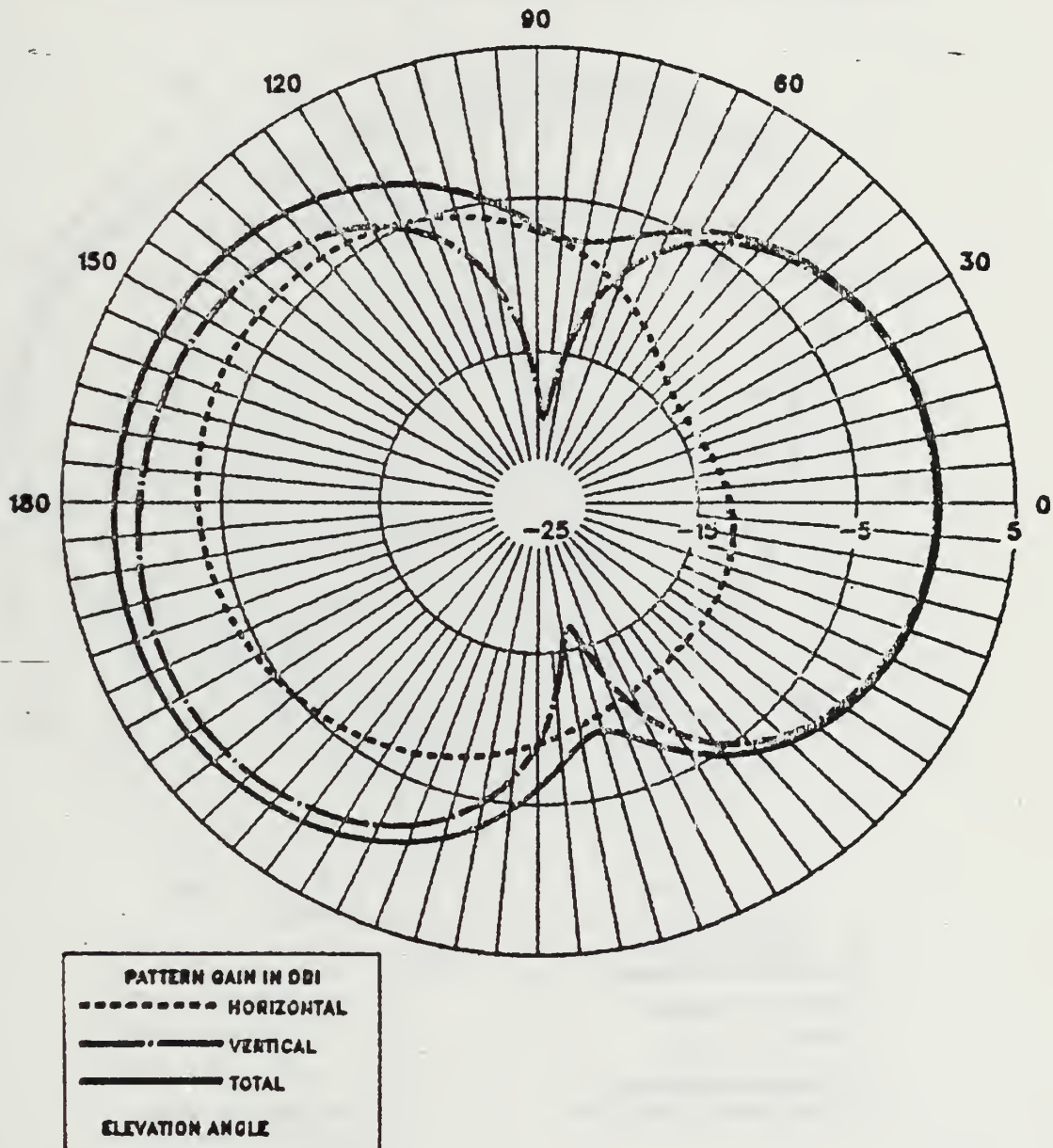
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ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=0



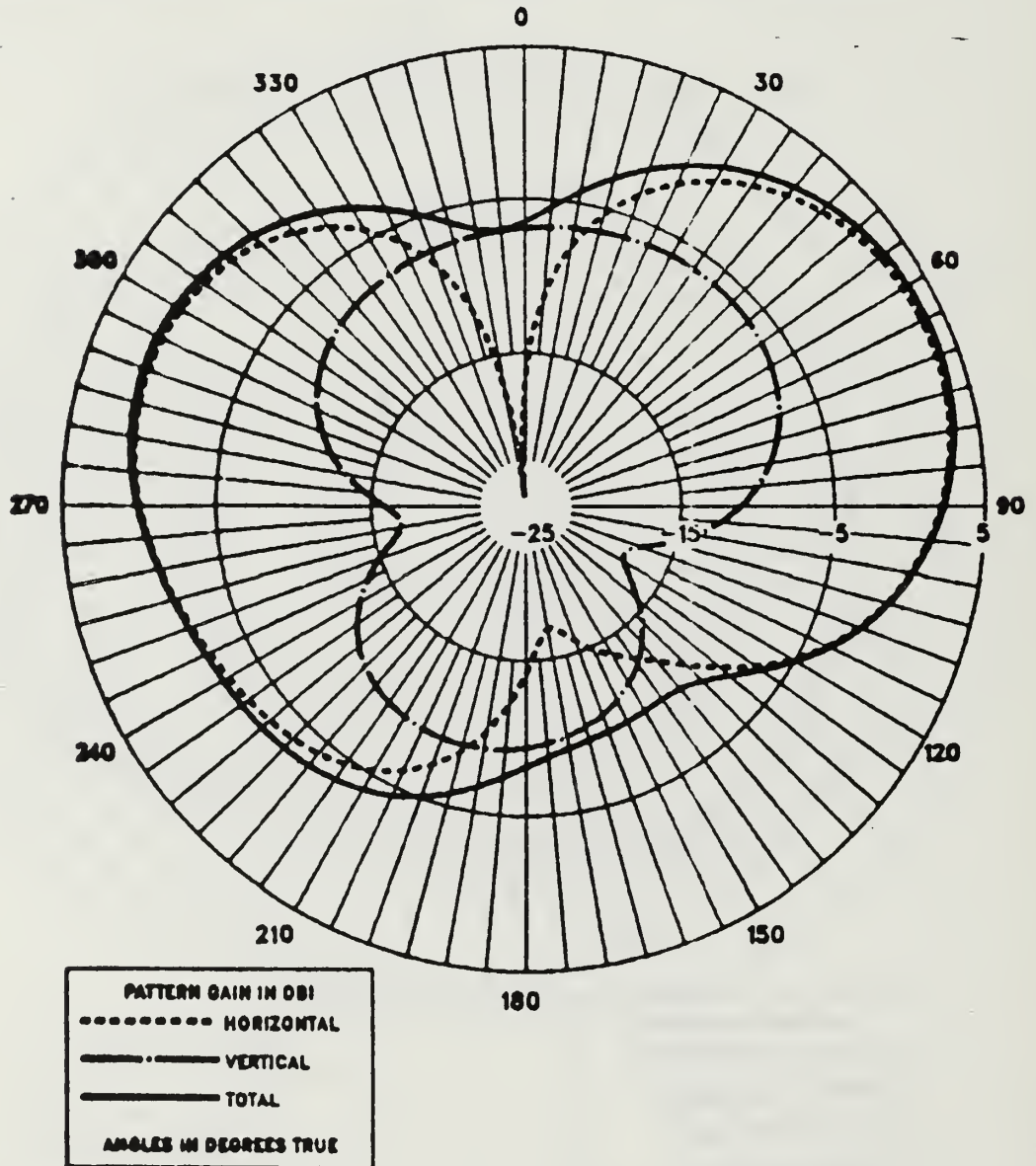
H65 IGUANA DATA RUN AT 8.984MHZ ON 8/24/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



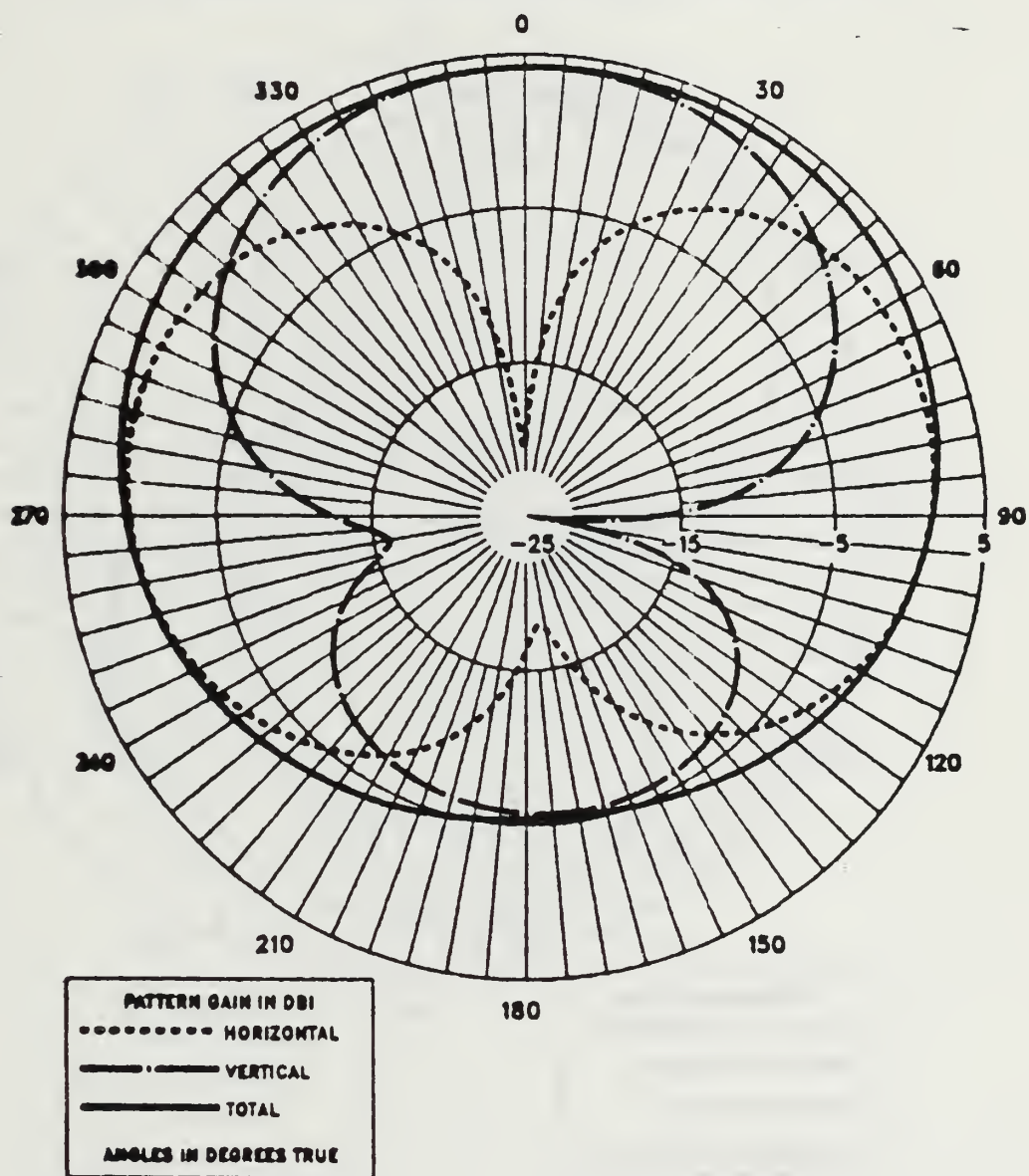
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



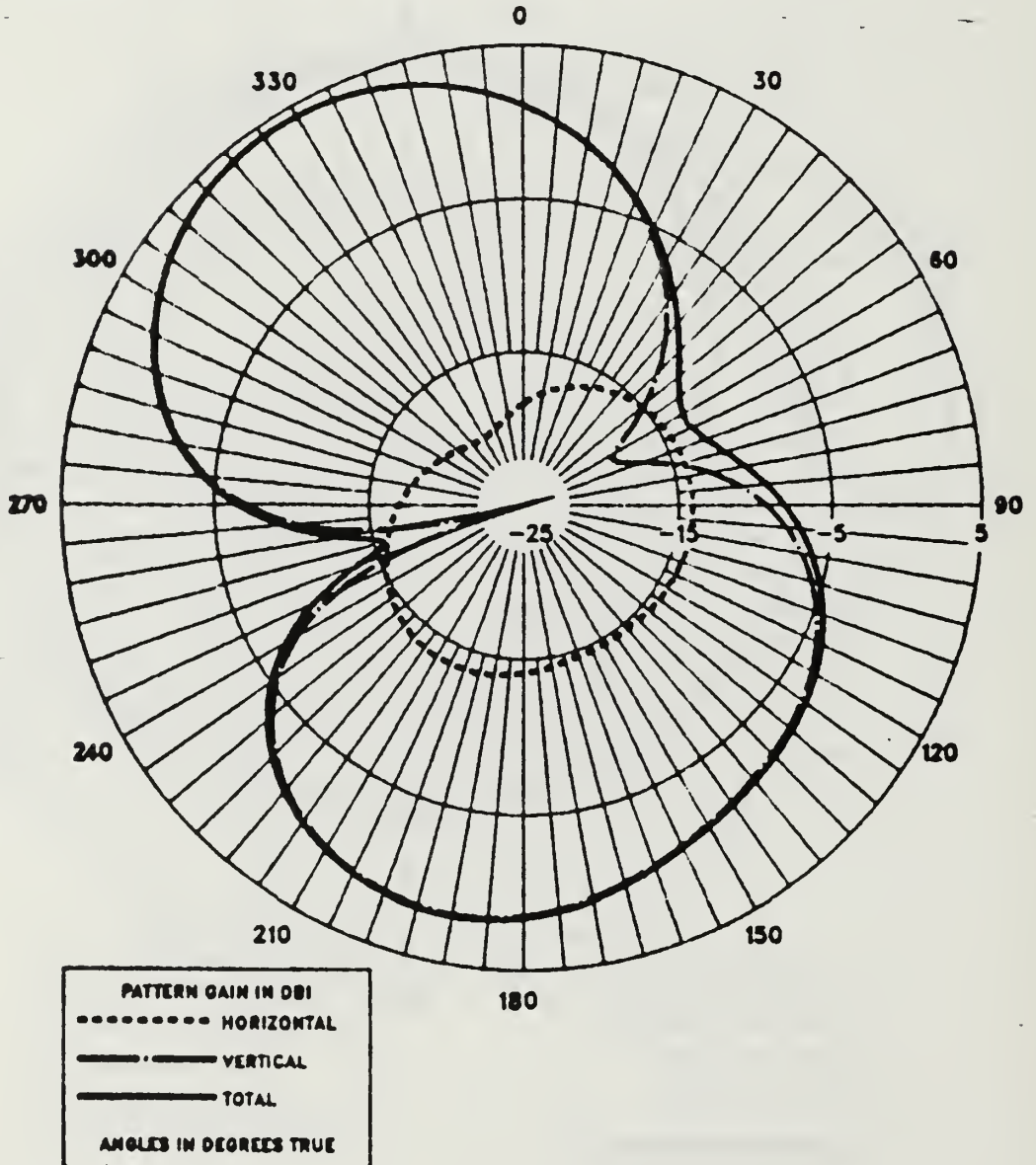
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



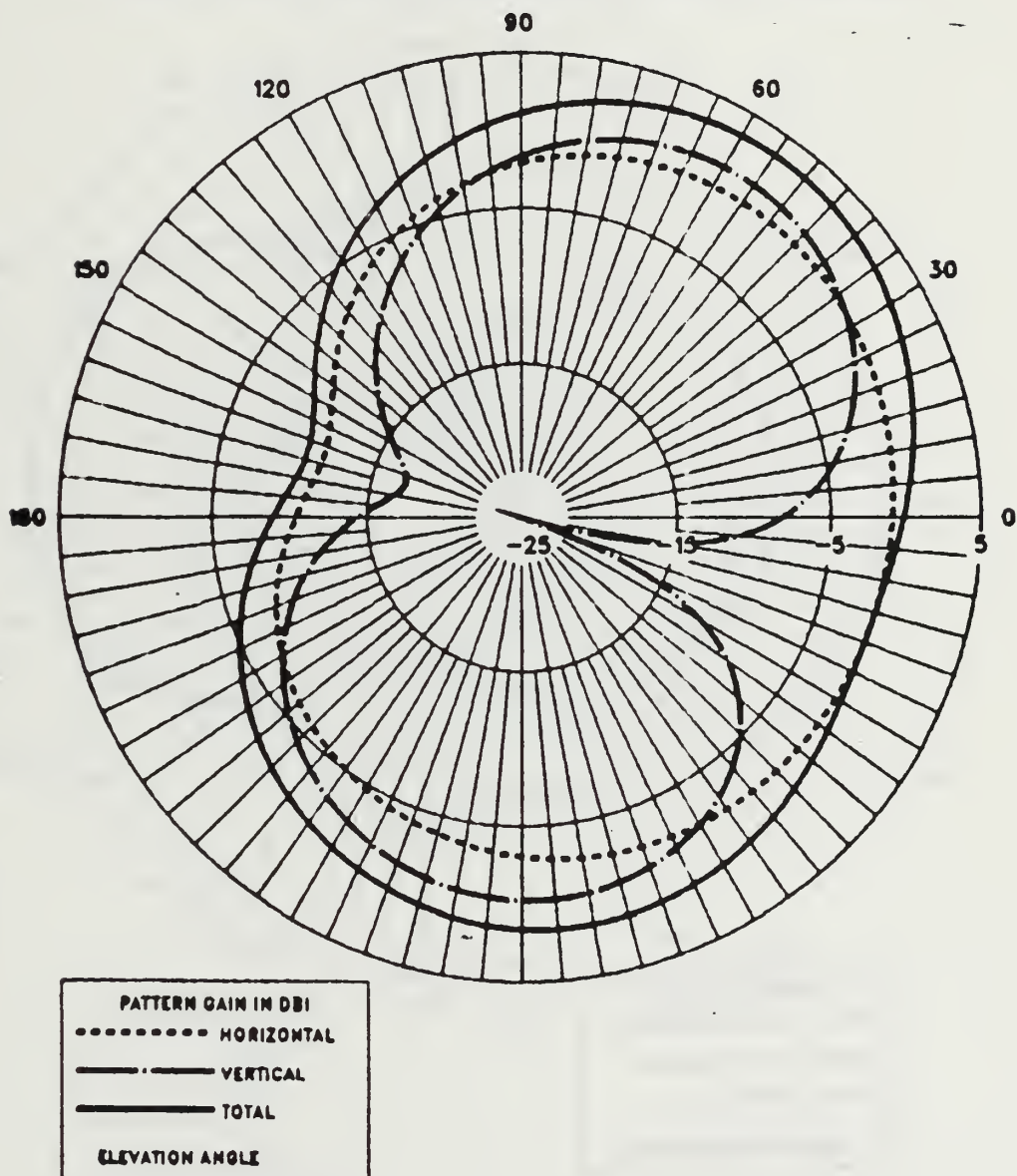
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



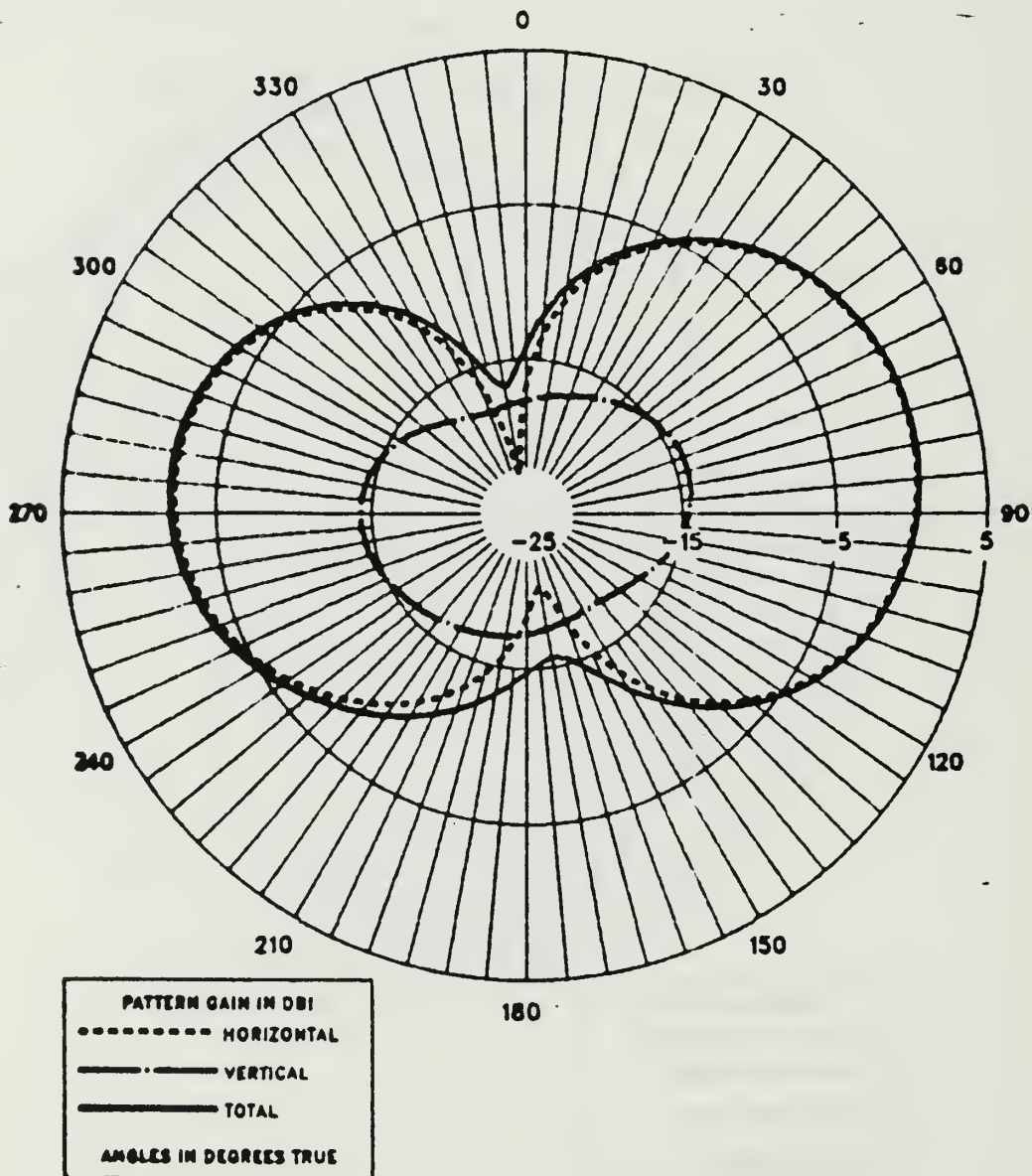
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



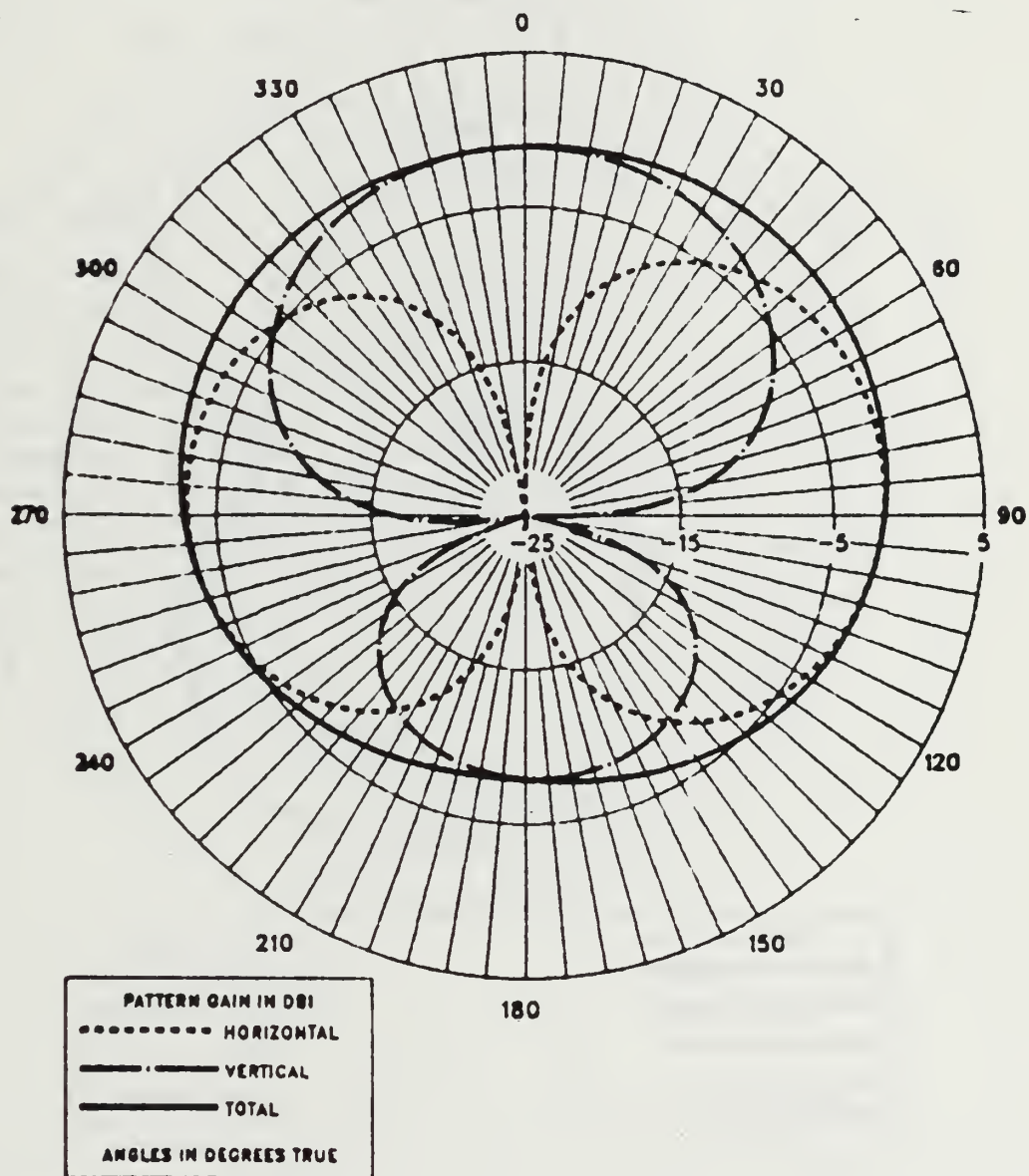
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



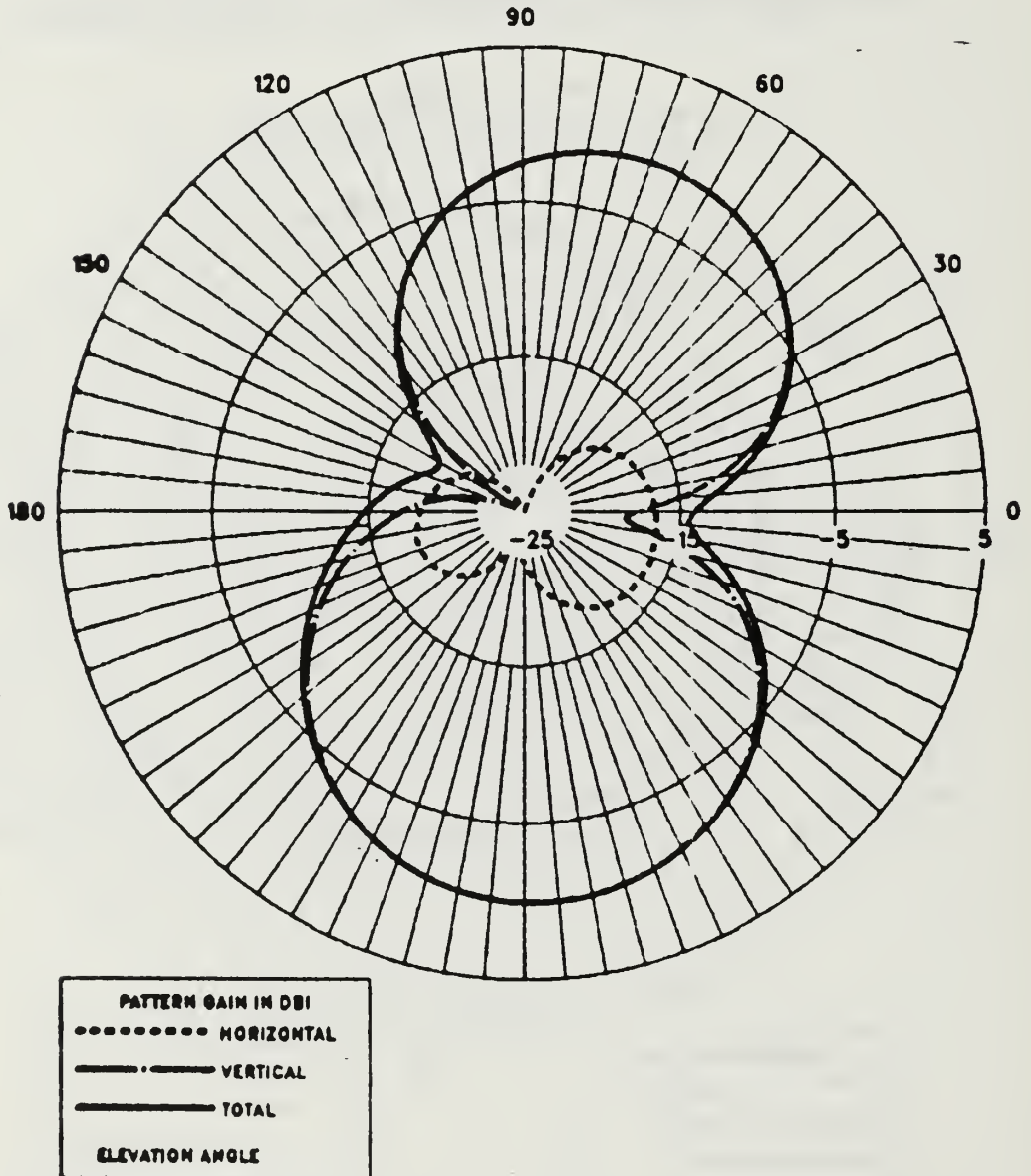
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



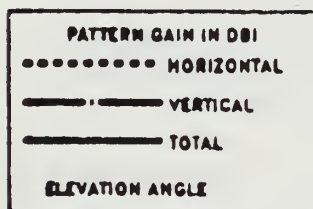
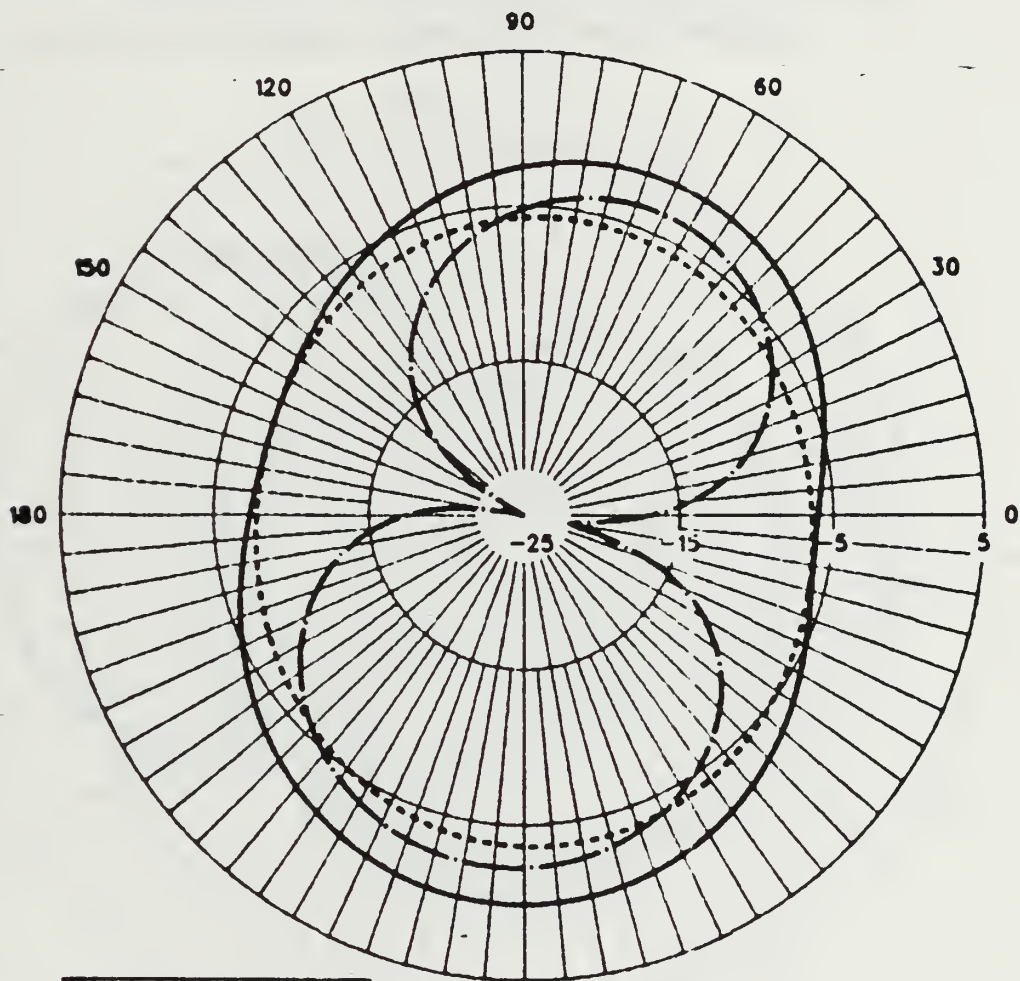
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



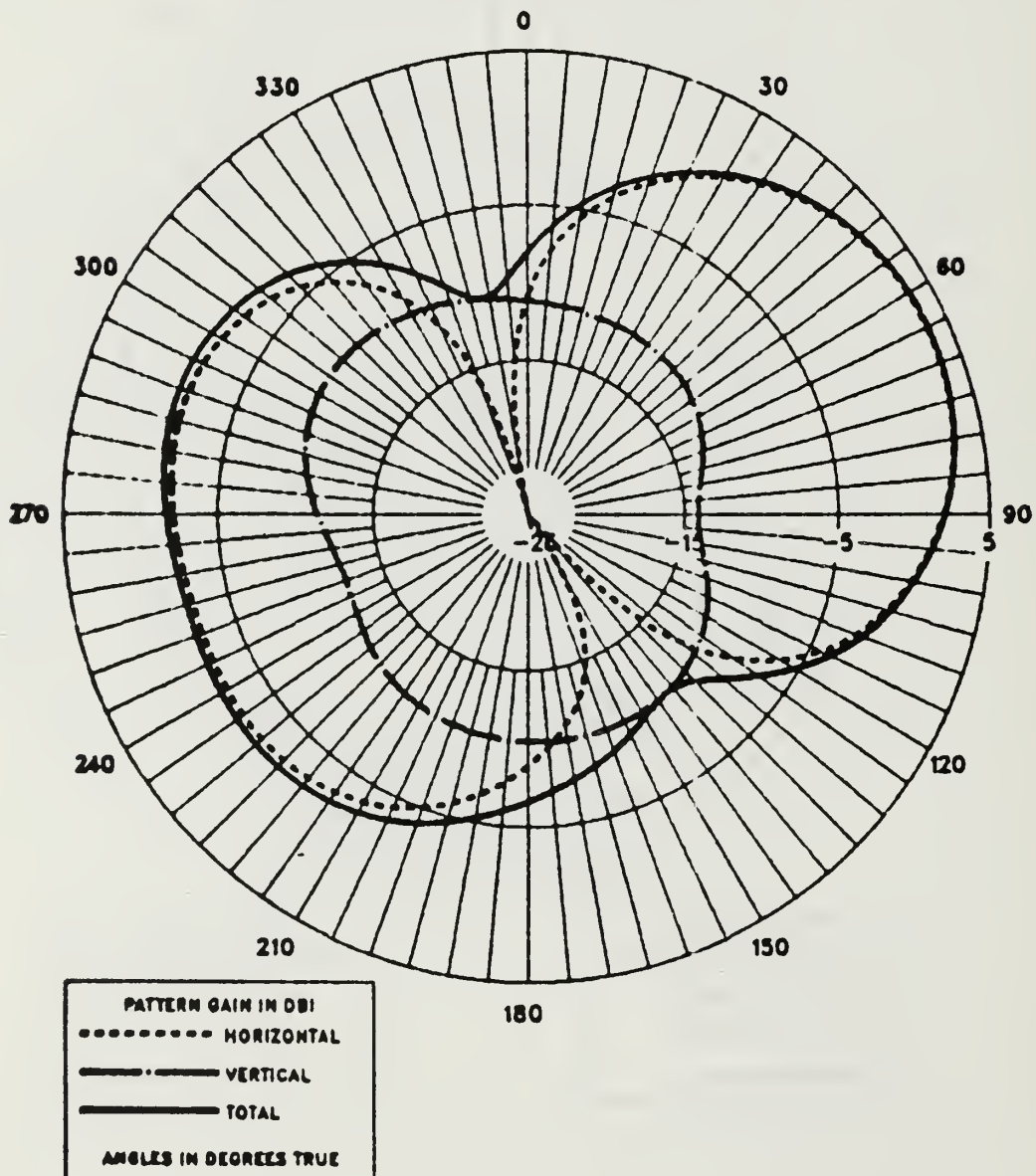
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



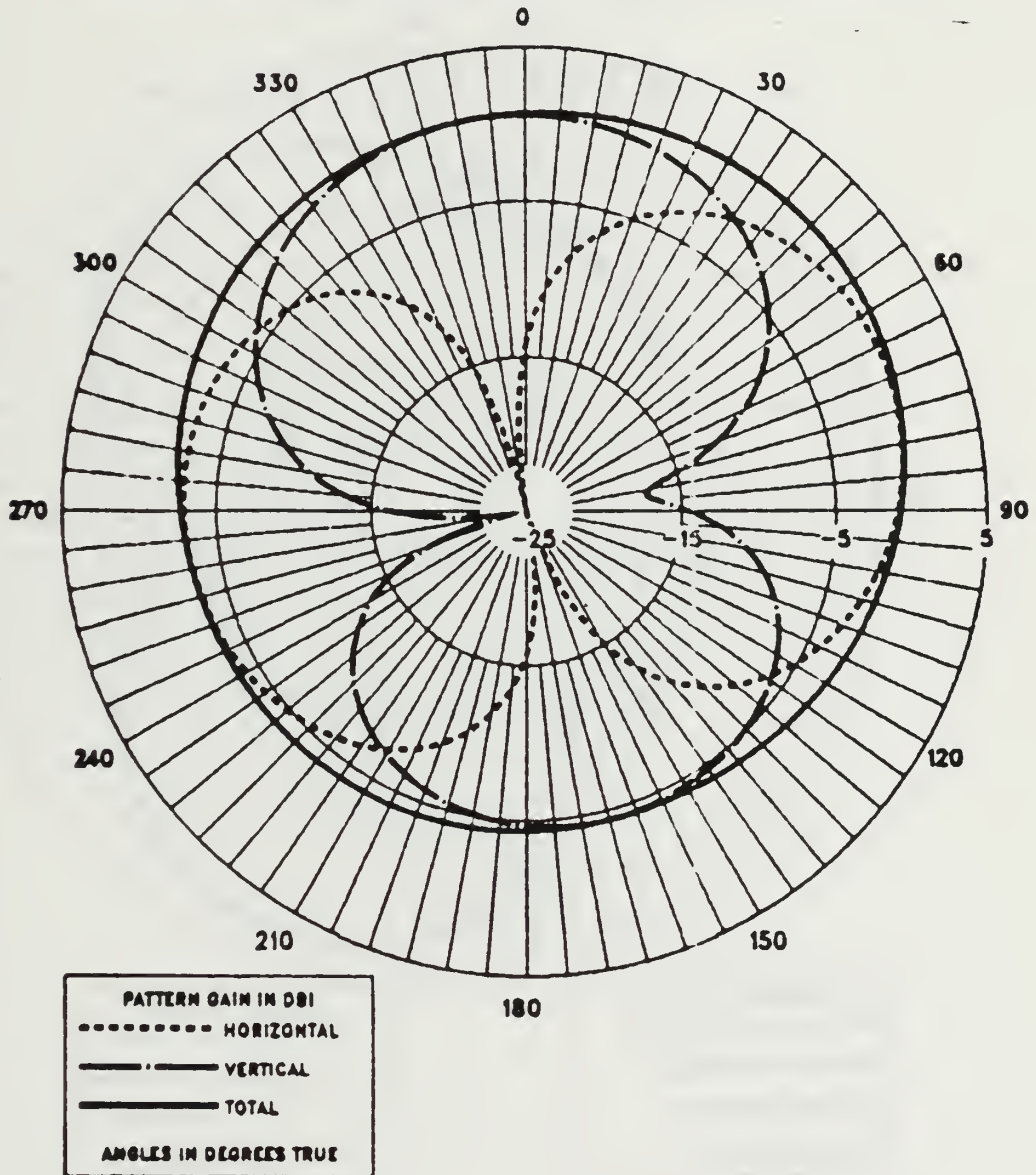
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



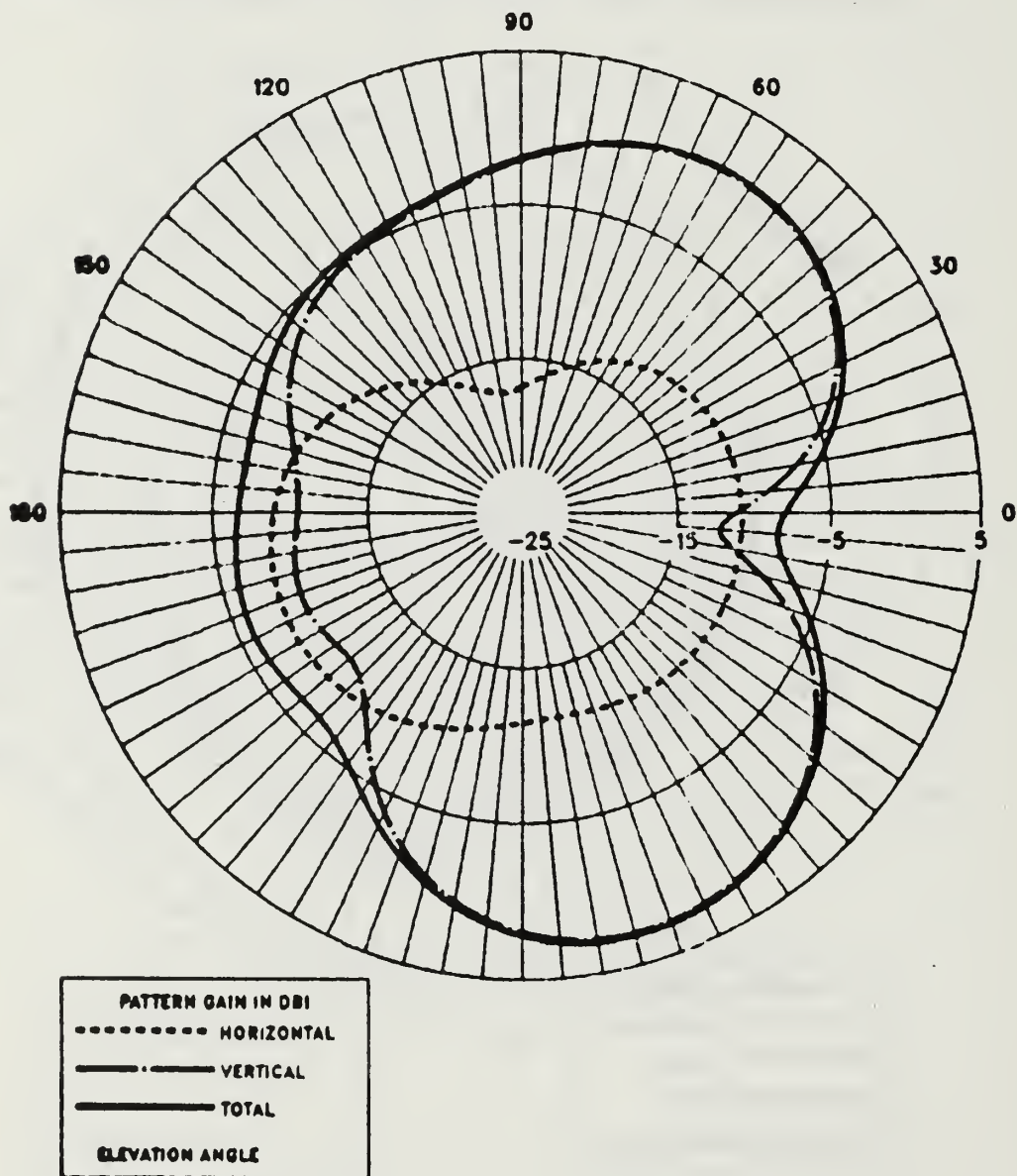
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CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



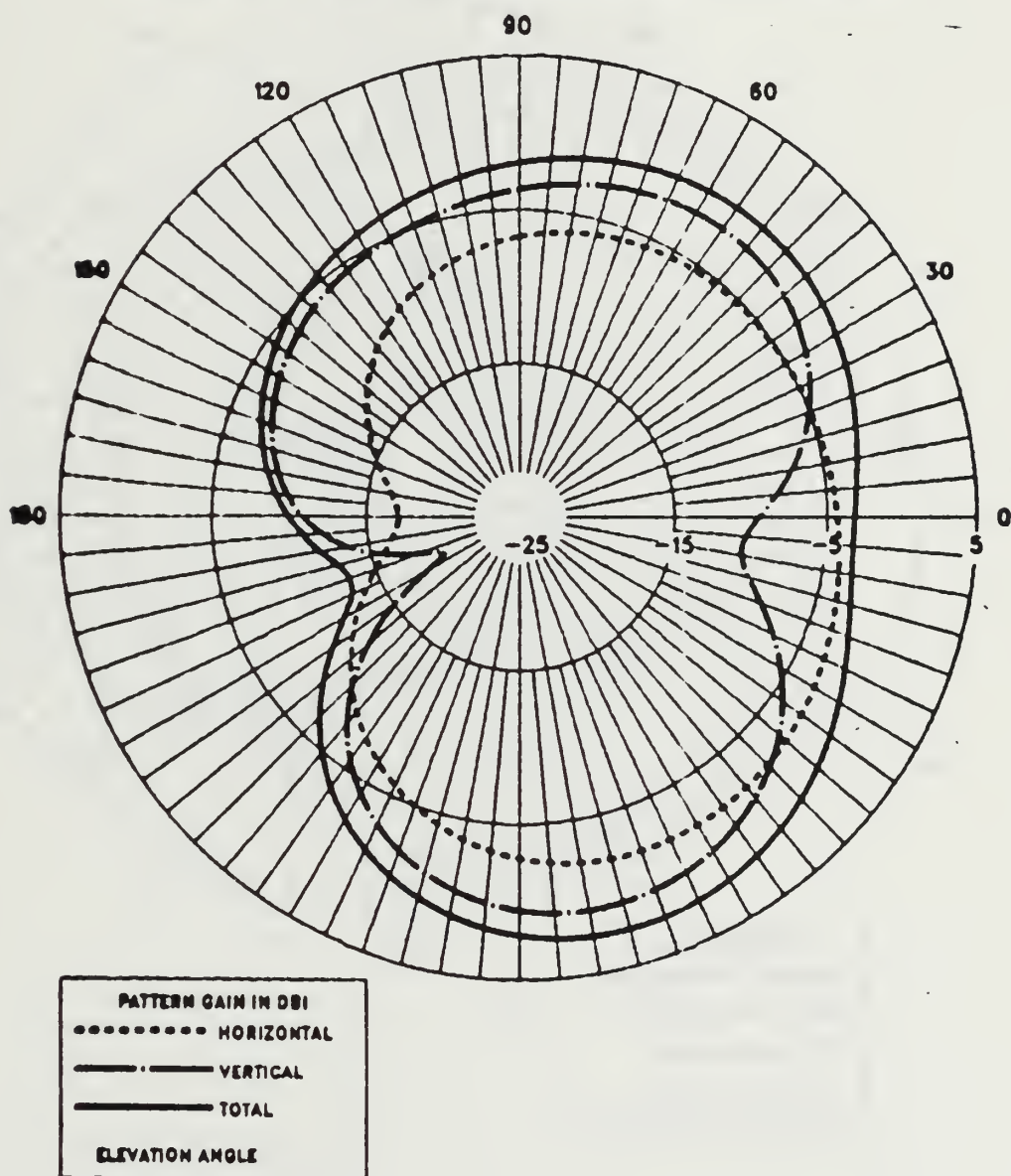
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



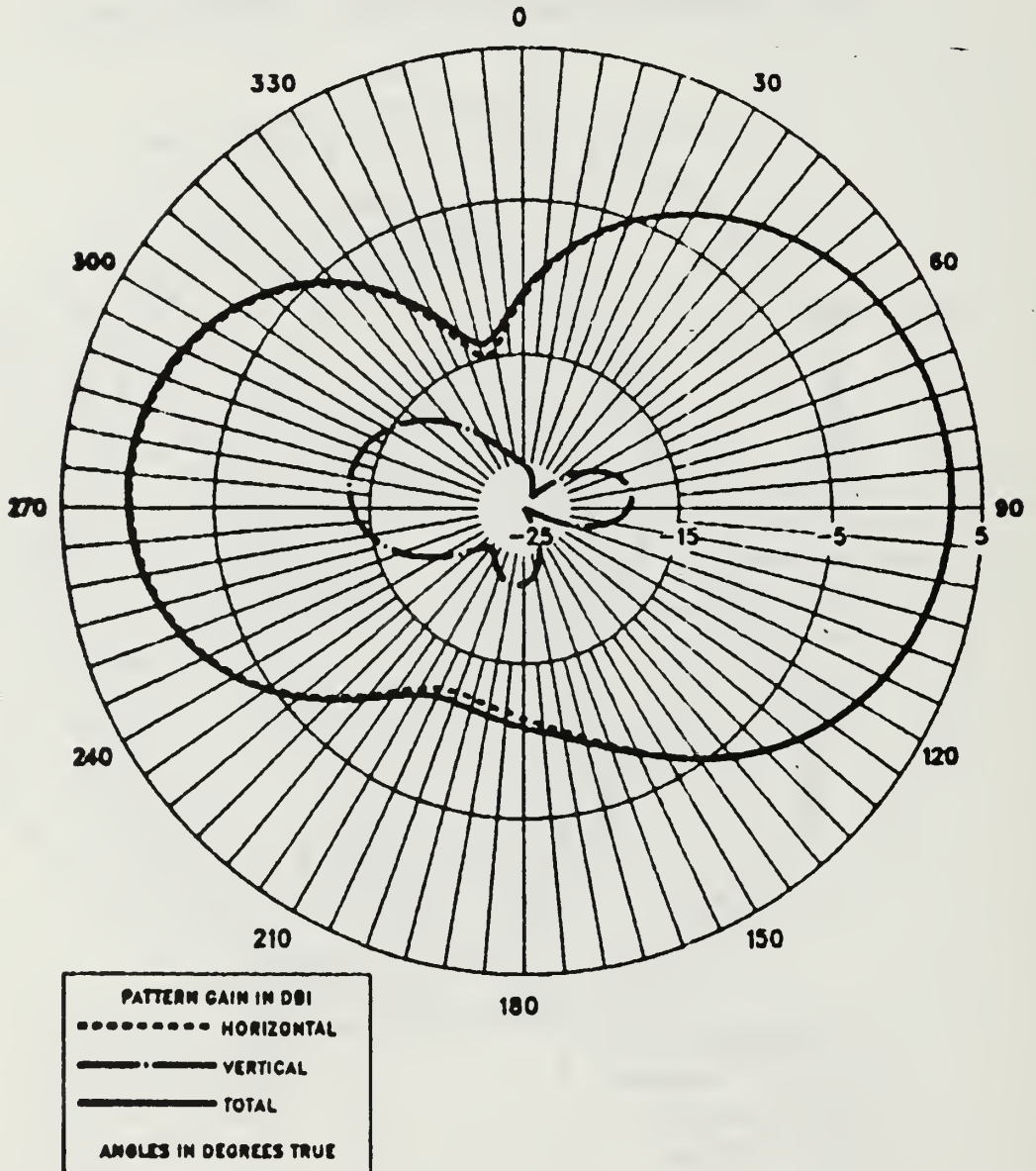
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CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



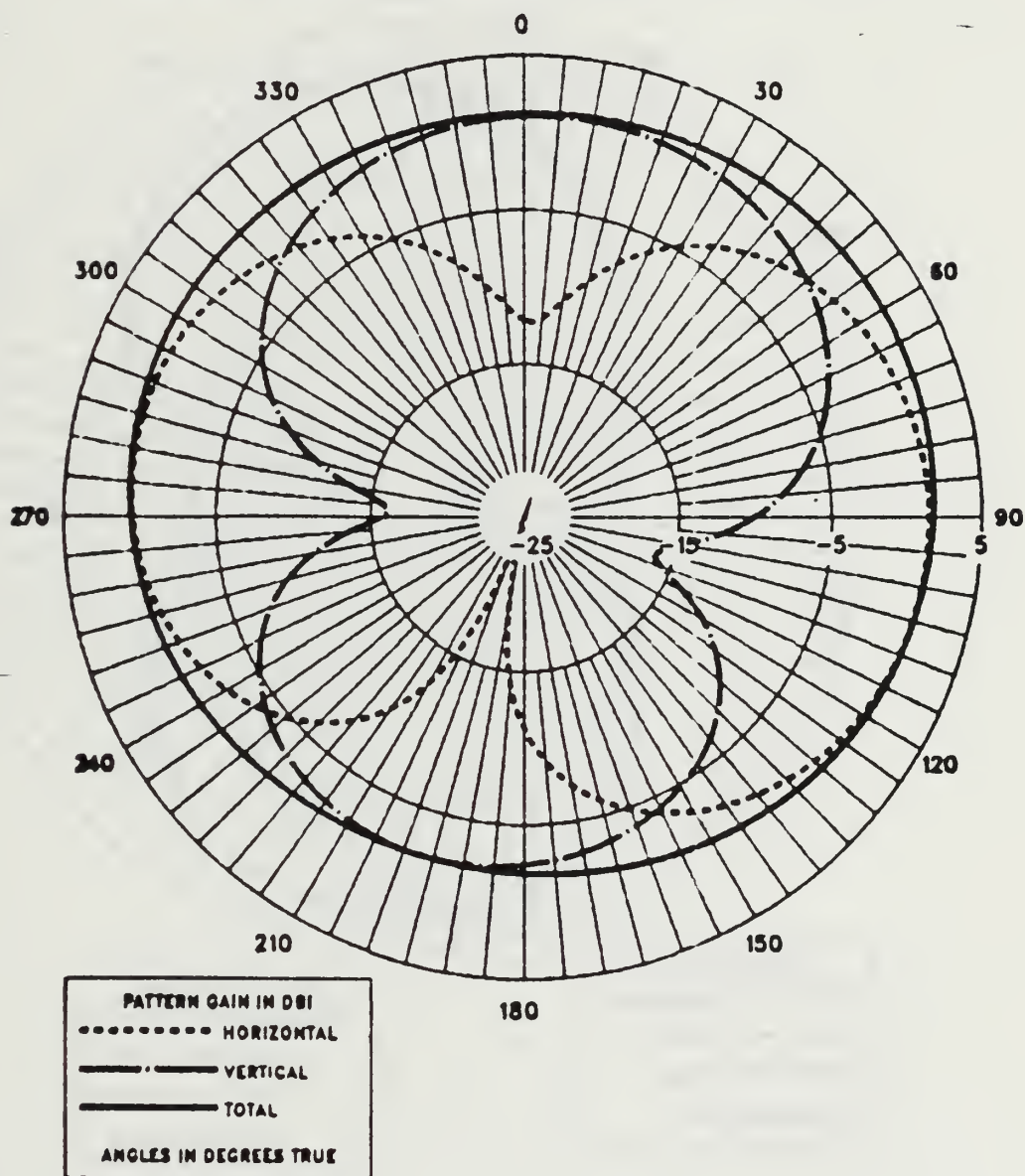
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

ARMY TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



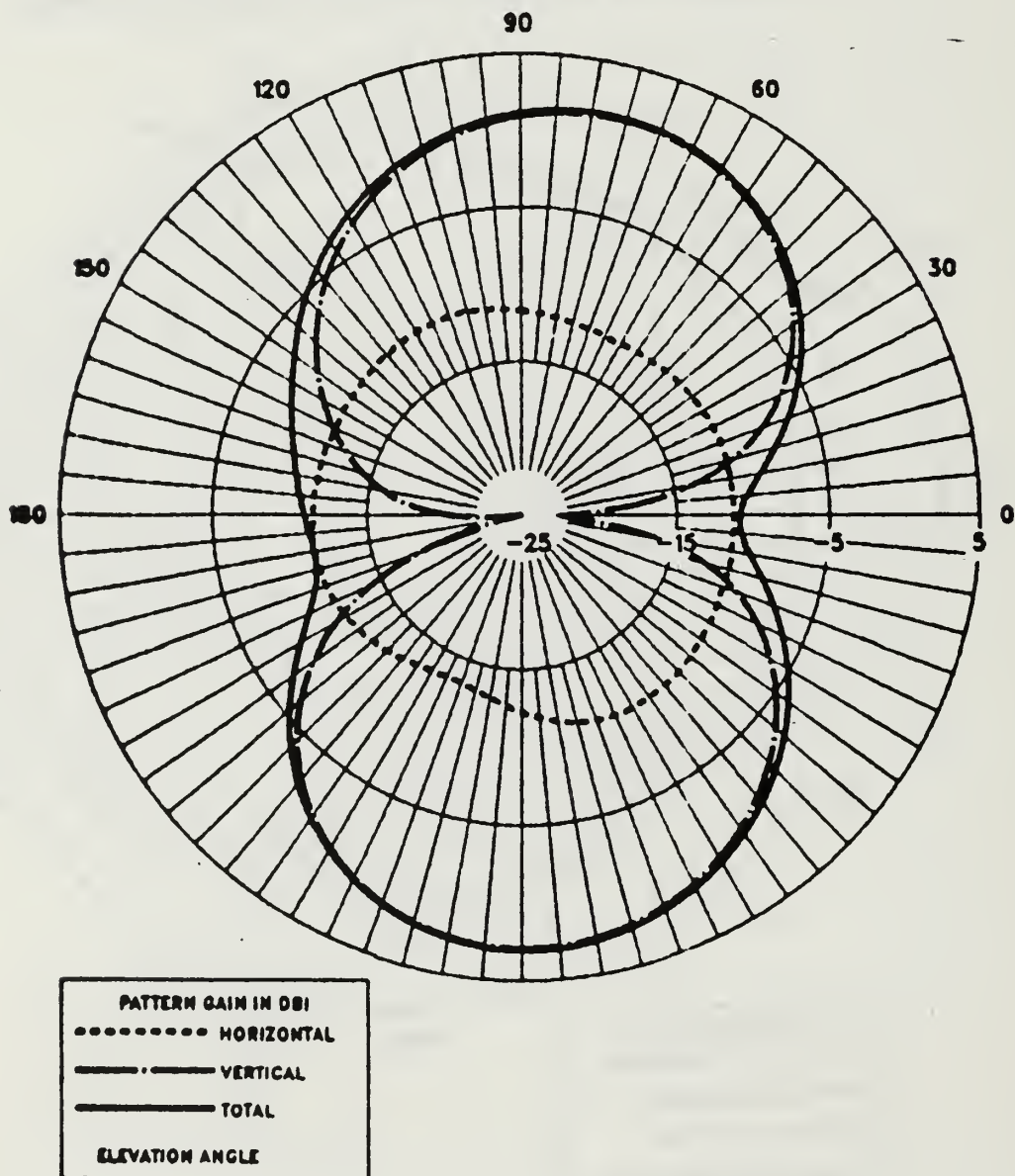
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

ARMY TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



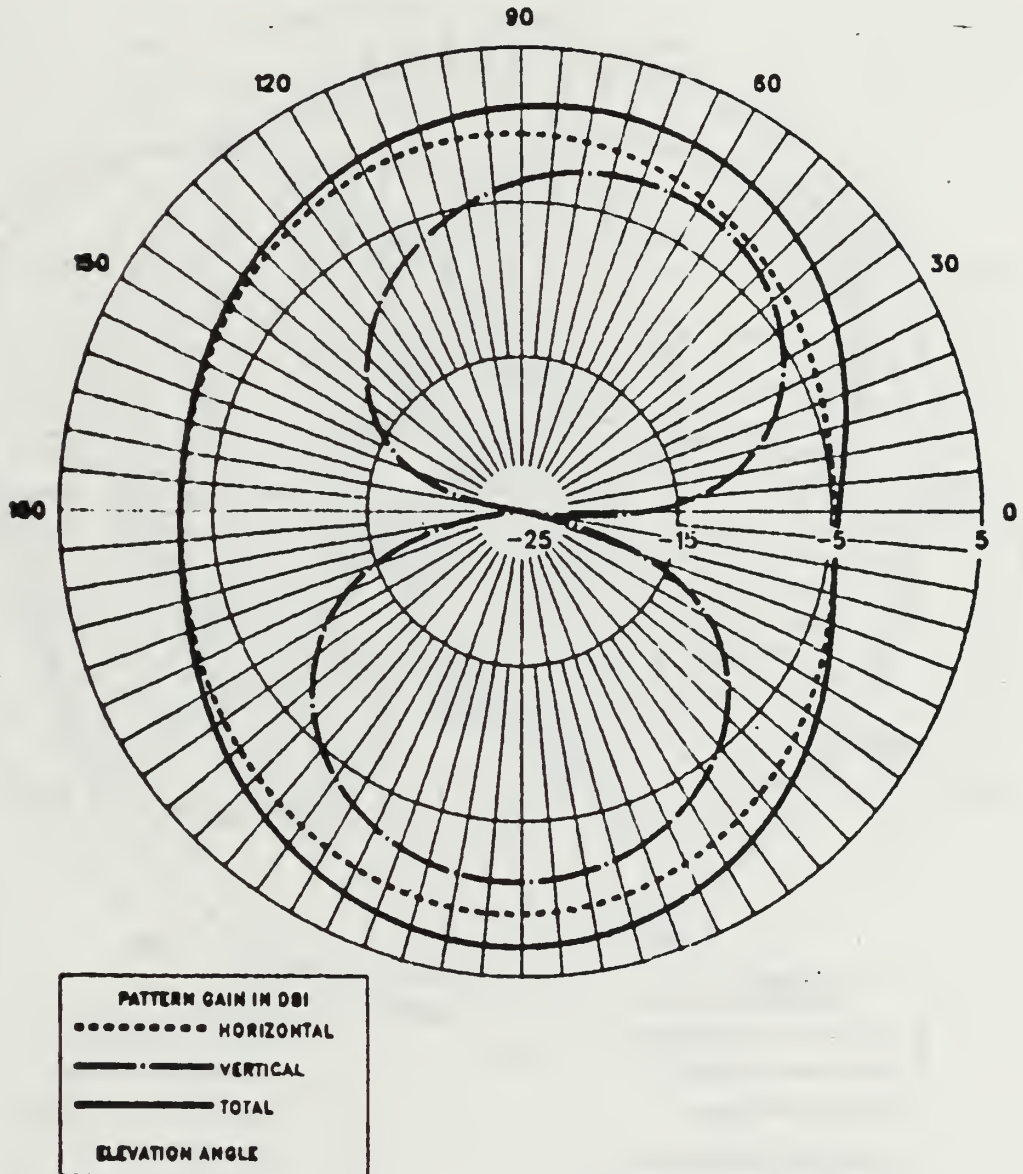
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

ARMY TUBE ANT, FREE SPACE, VERT CUT, $\Phi=0$



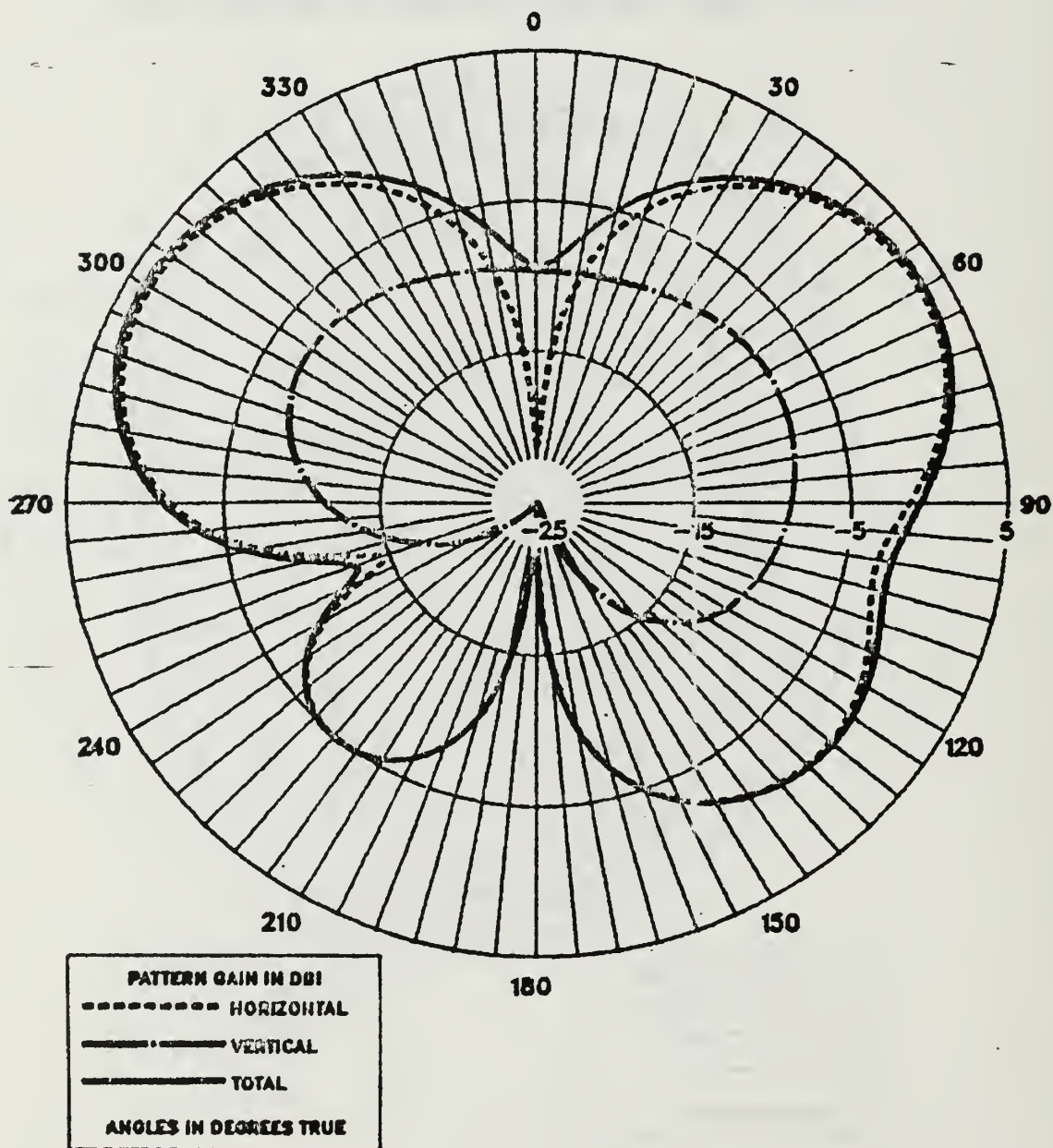
H60 IGUANA DATA RUN AT 13.974 MHZ ON 9/11/87

ARMY TUBE ANT, FREE SPACE, VERT CUT, PHI=45



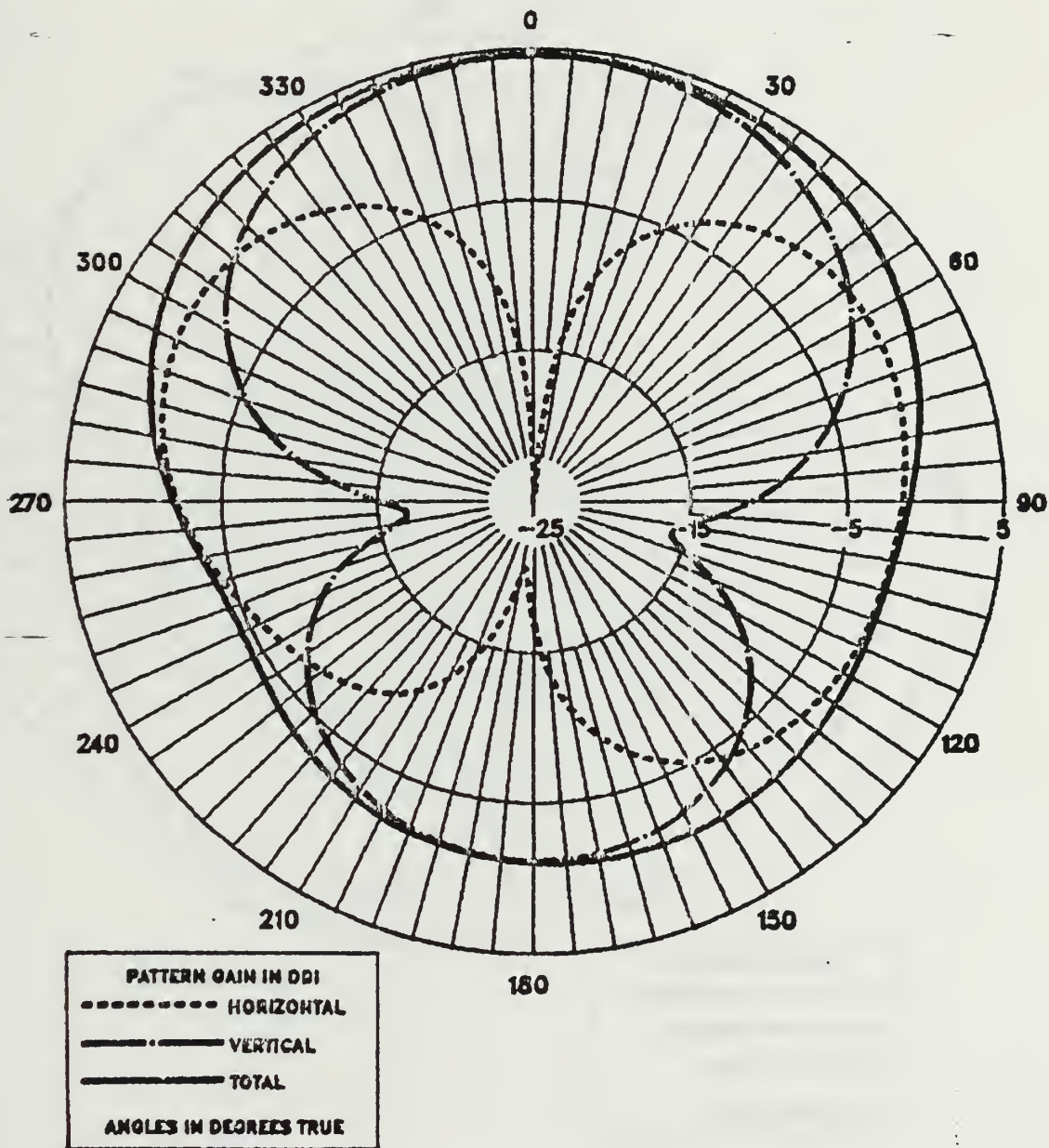
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=90



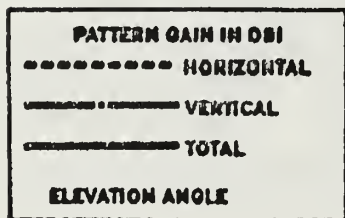
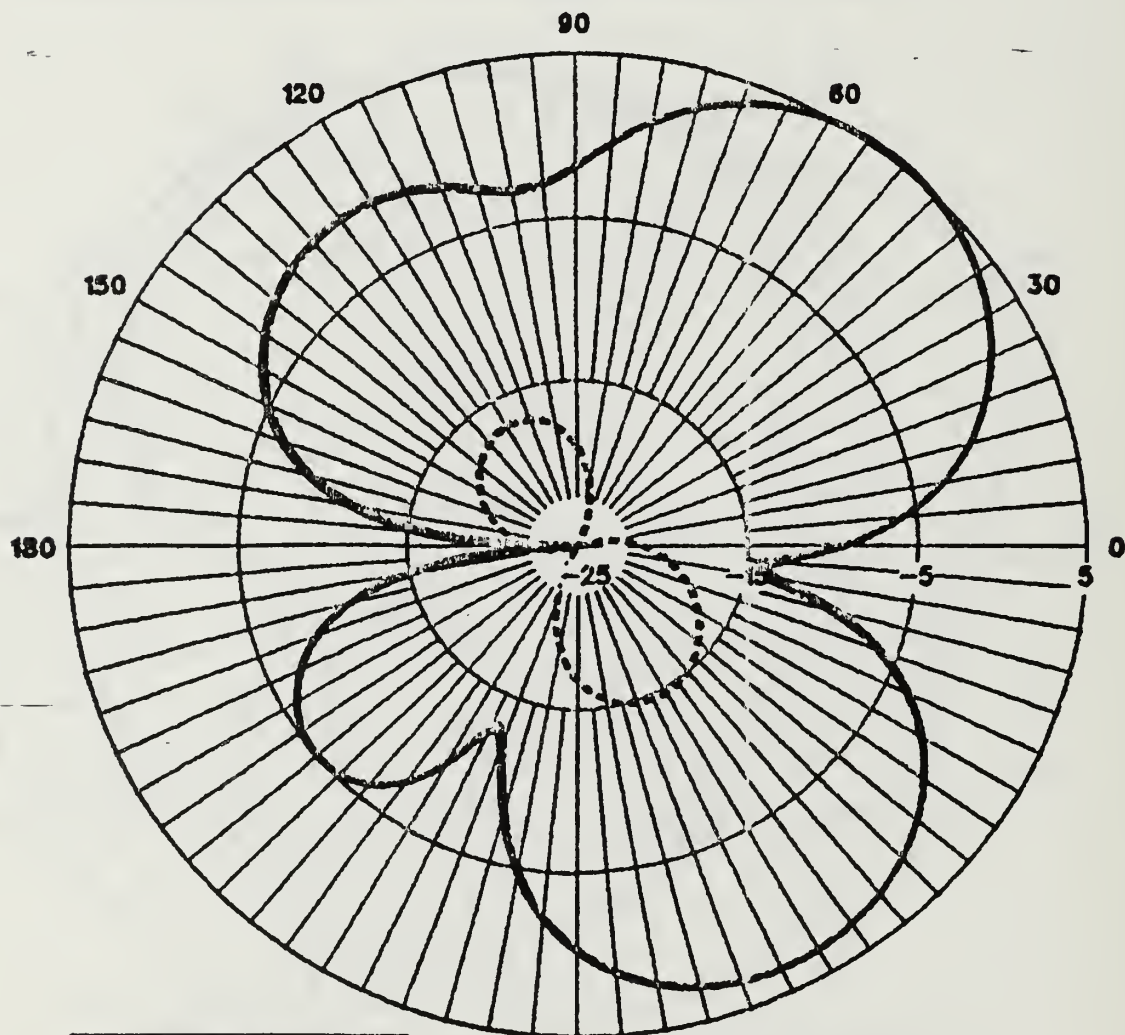
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, HORIZ CUT, THETA=26



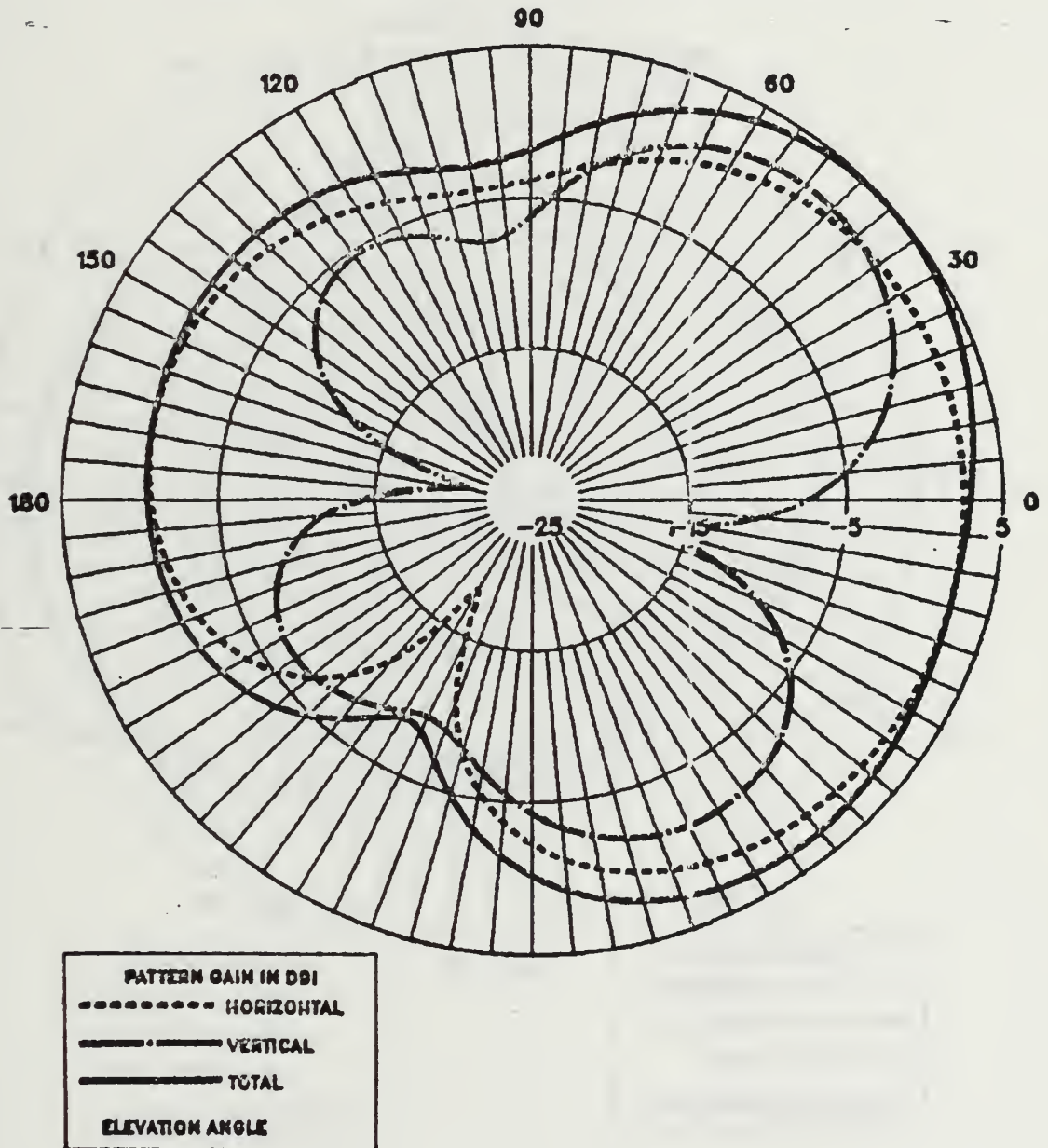
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=0



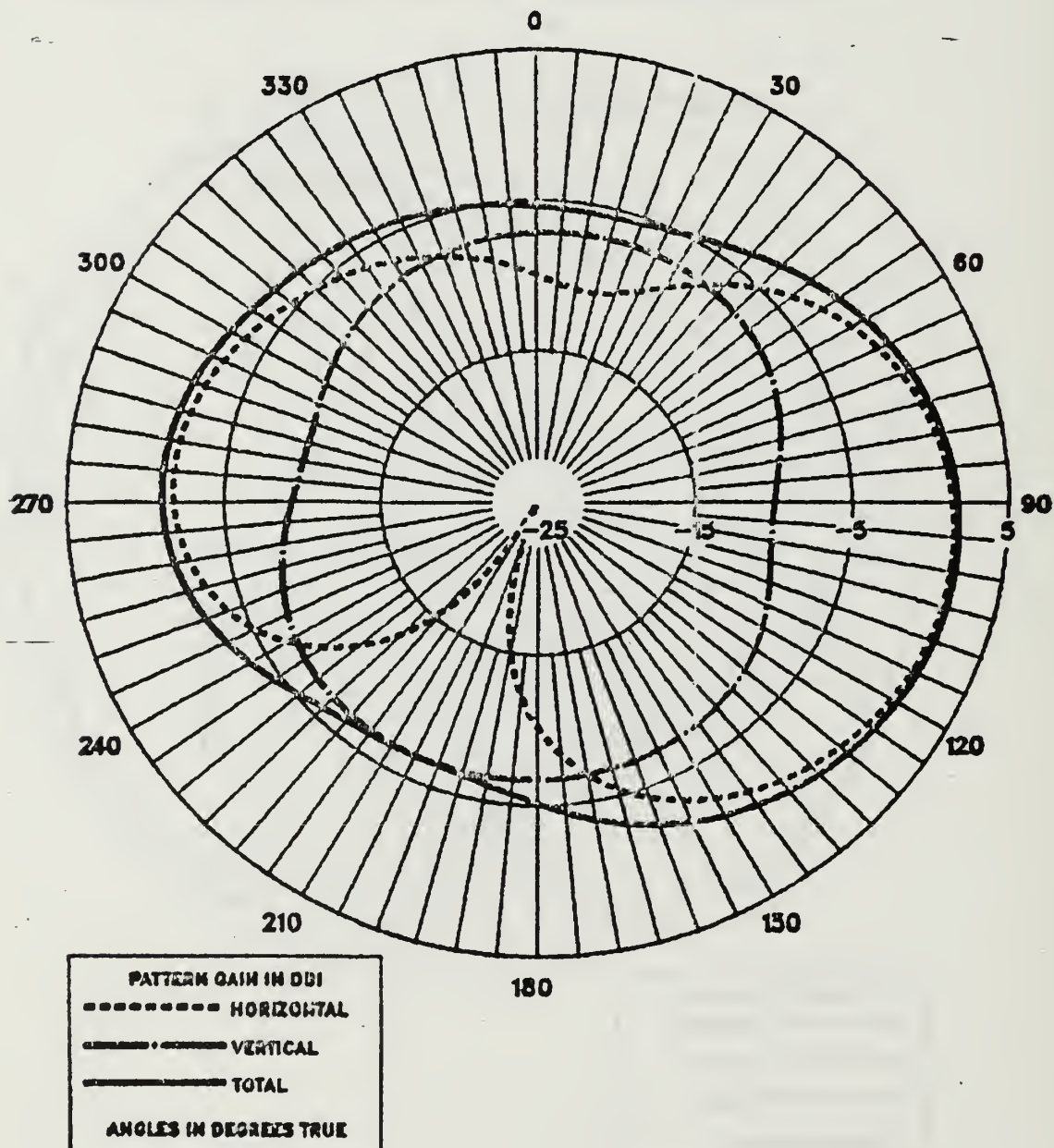
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

LONG-WIRE ANT, FREE SPACE, VERT CUT, PHI=45



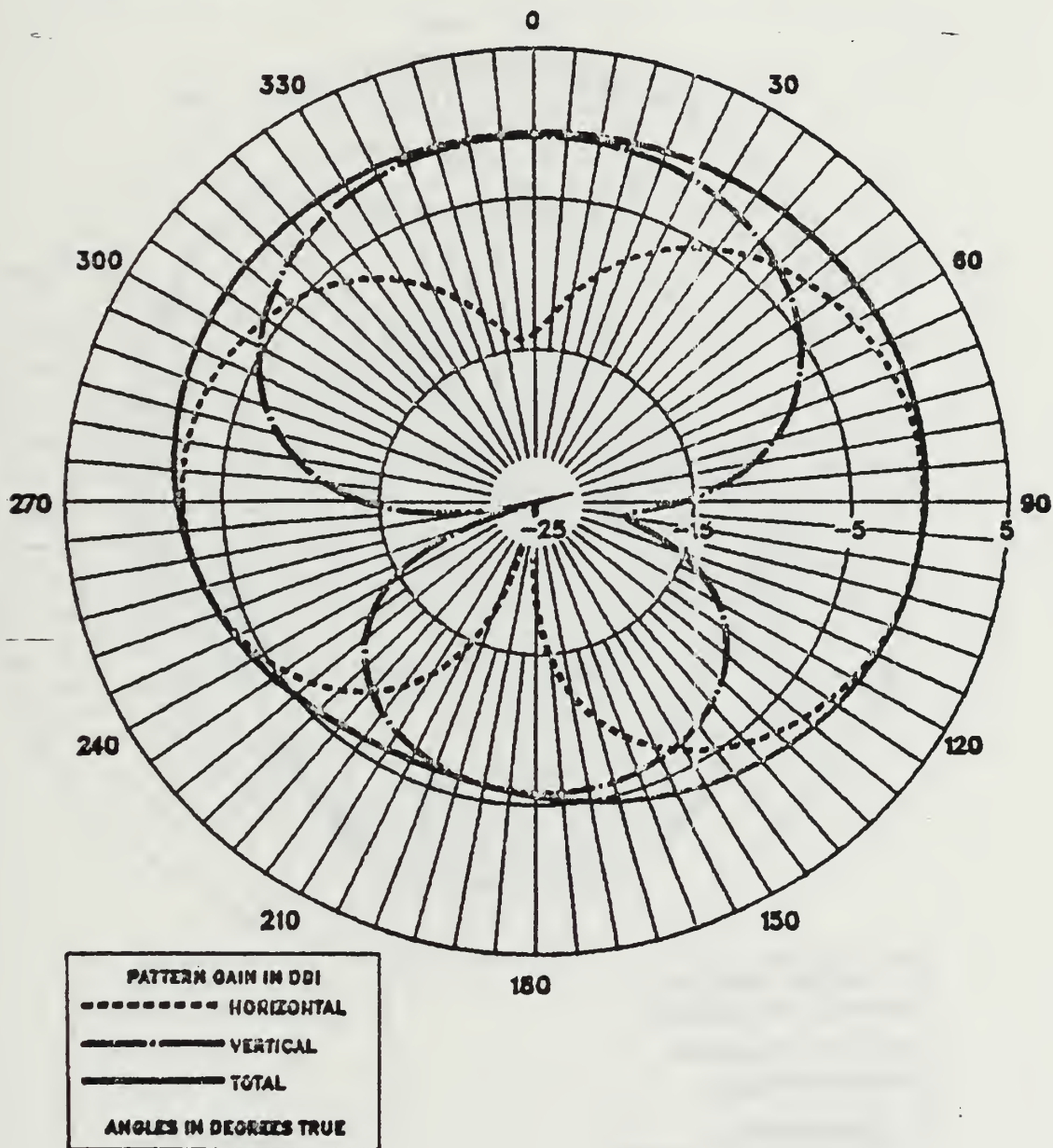
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



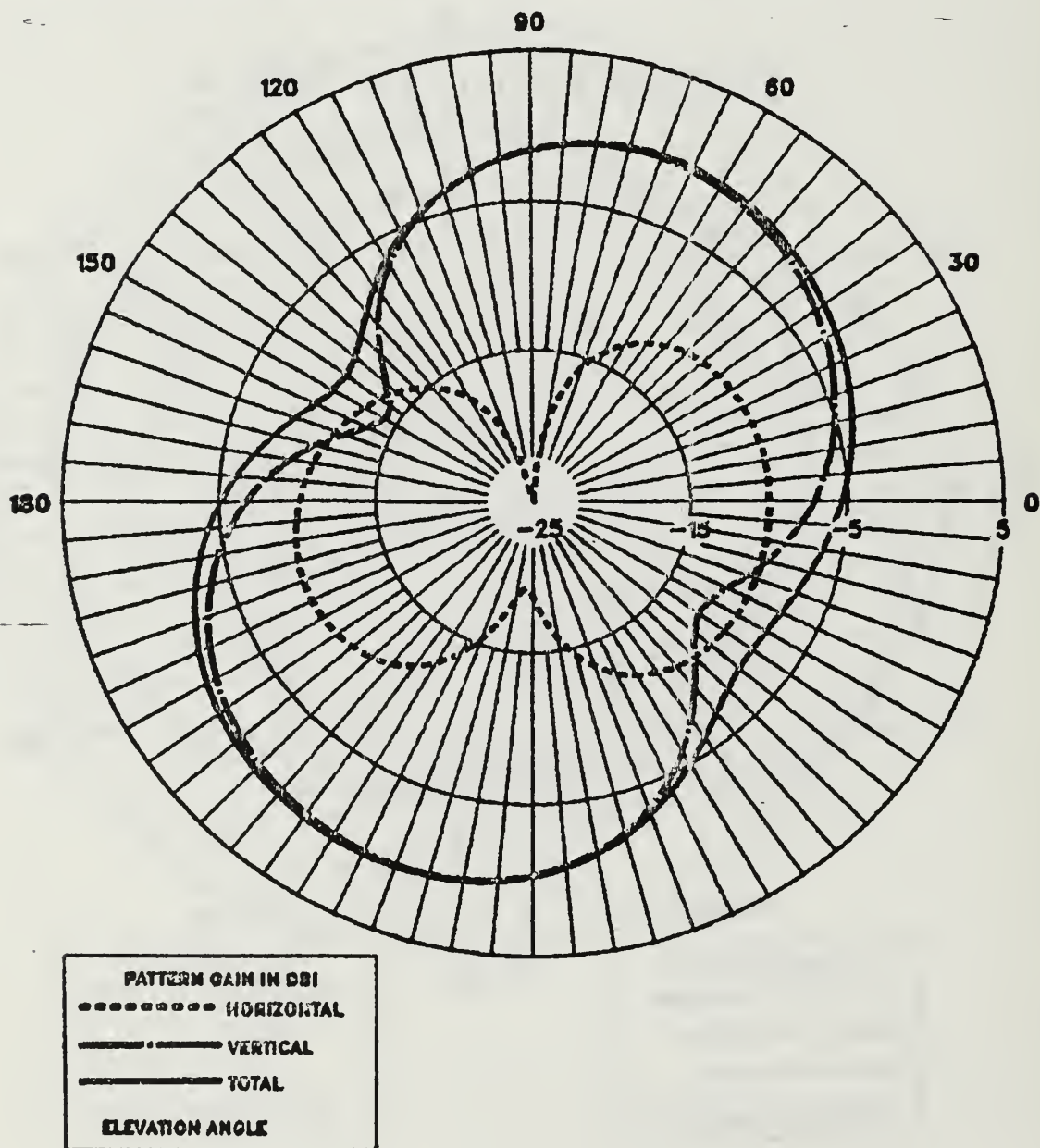
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

NAVY 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



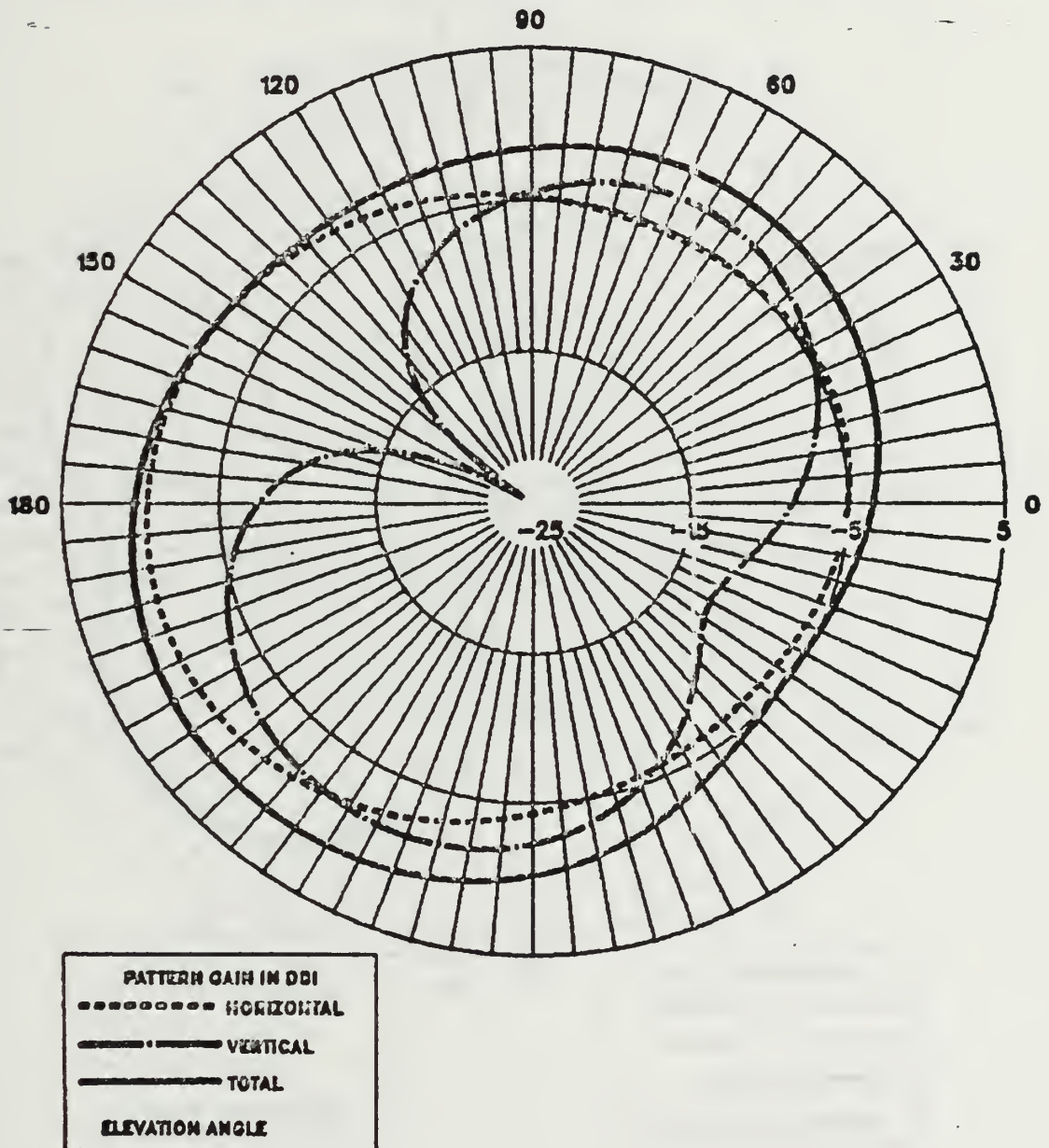
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



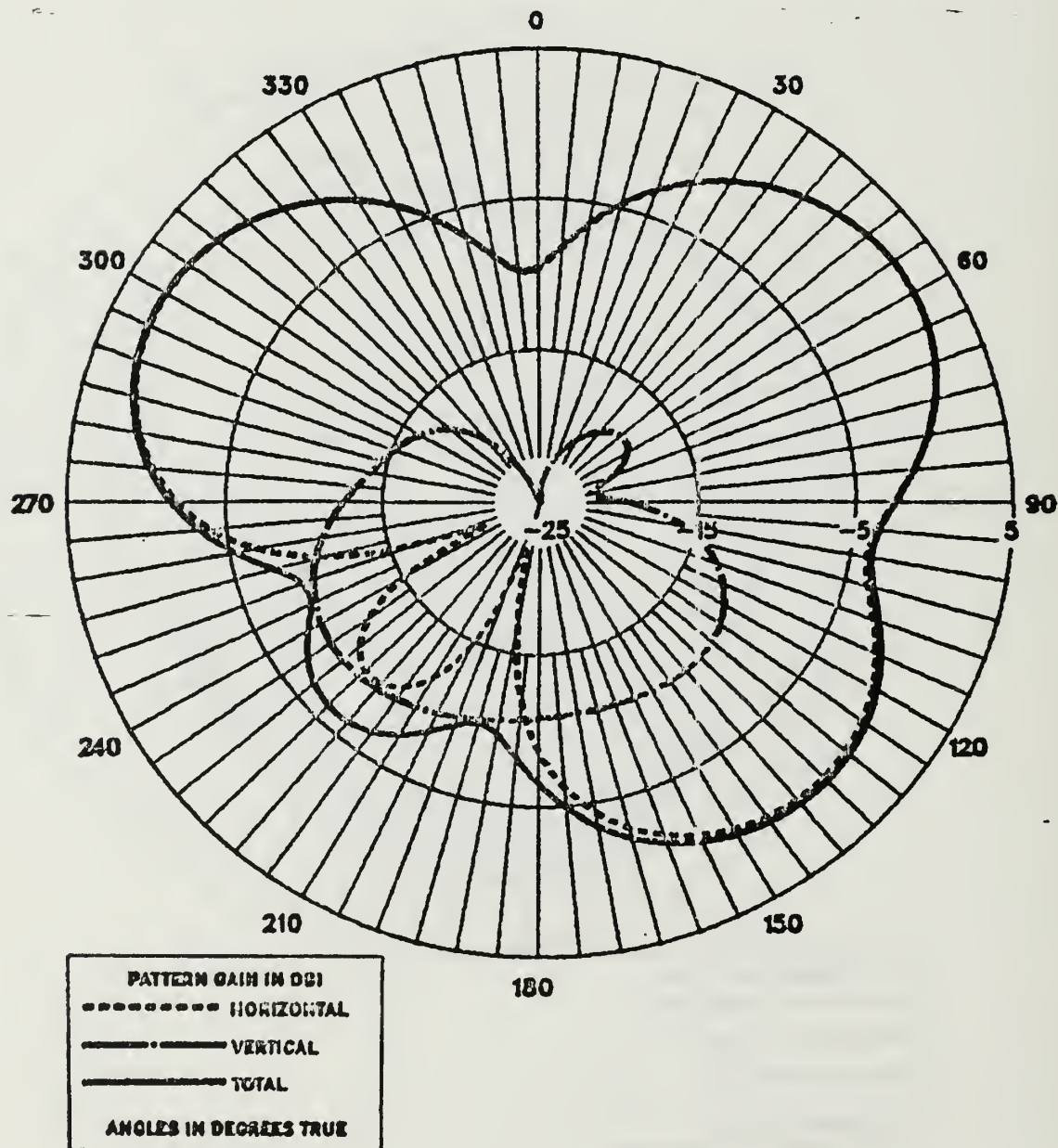
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

NAVY 437R-2 ANT, FREE SPACE, VERT CUT, $\Phi=45$



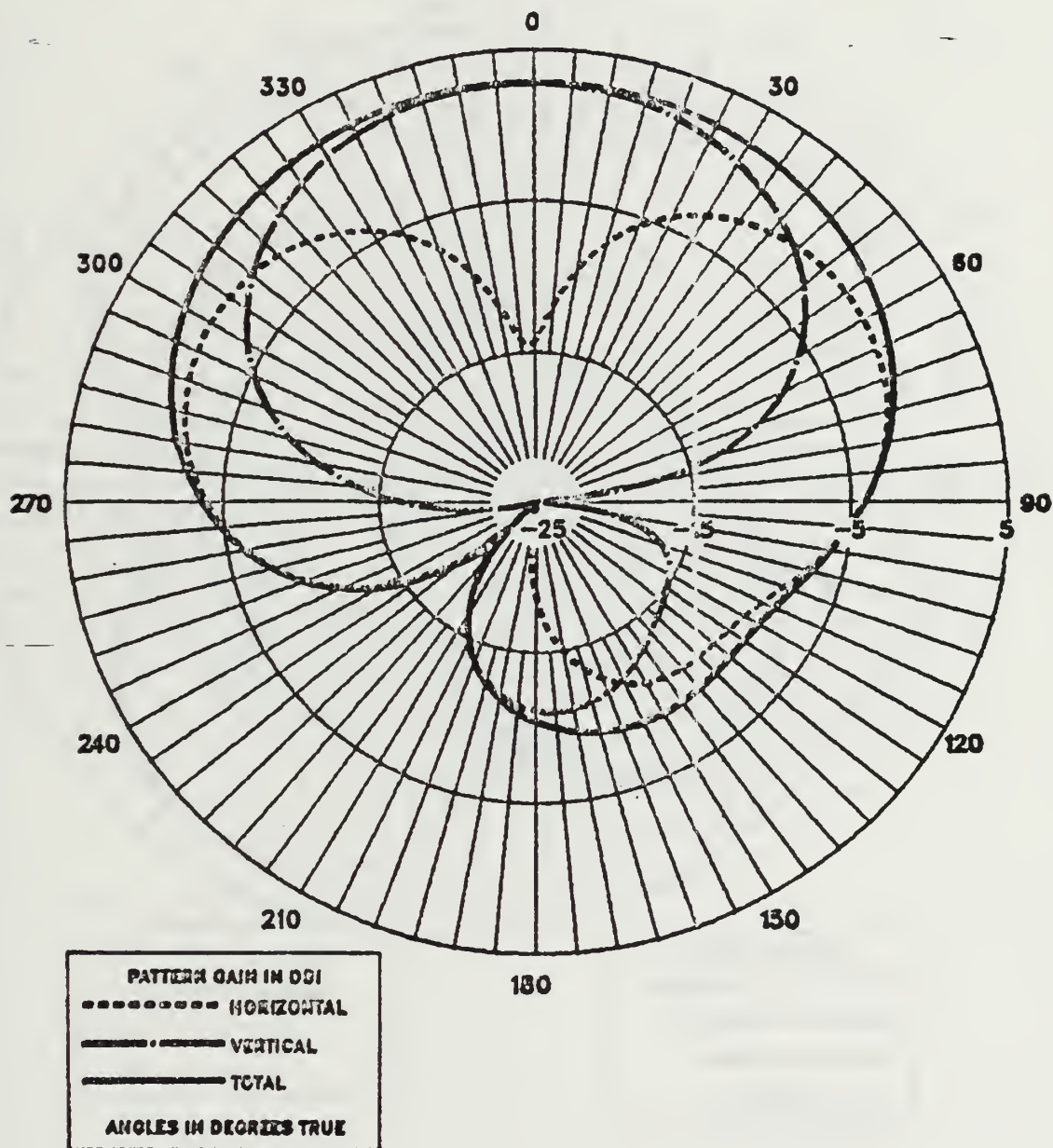
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=90



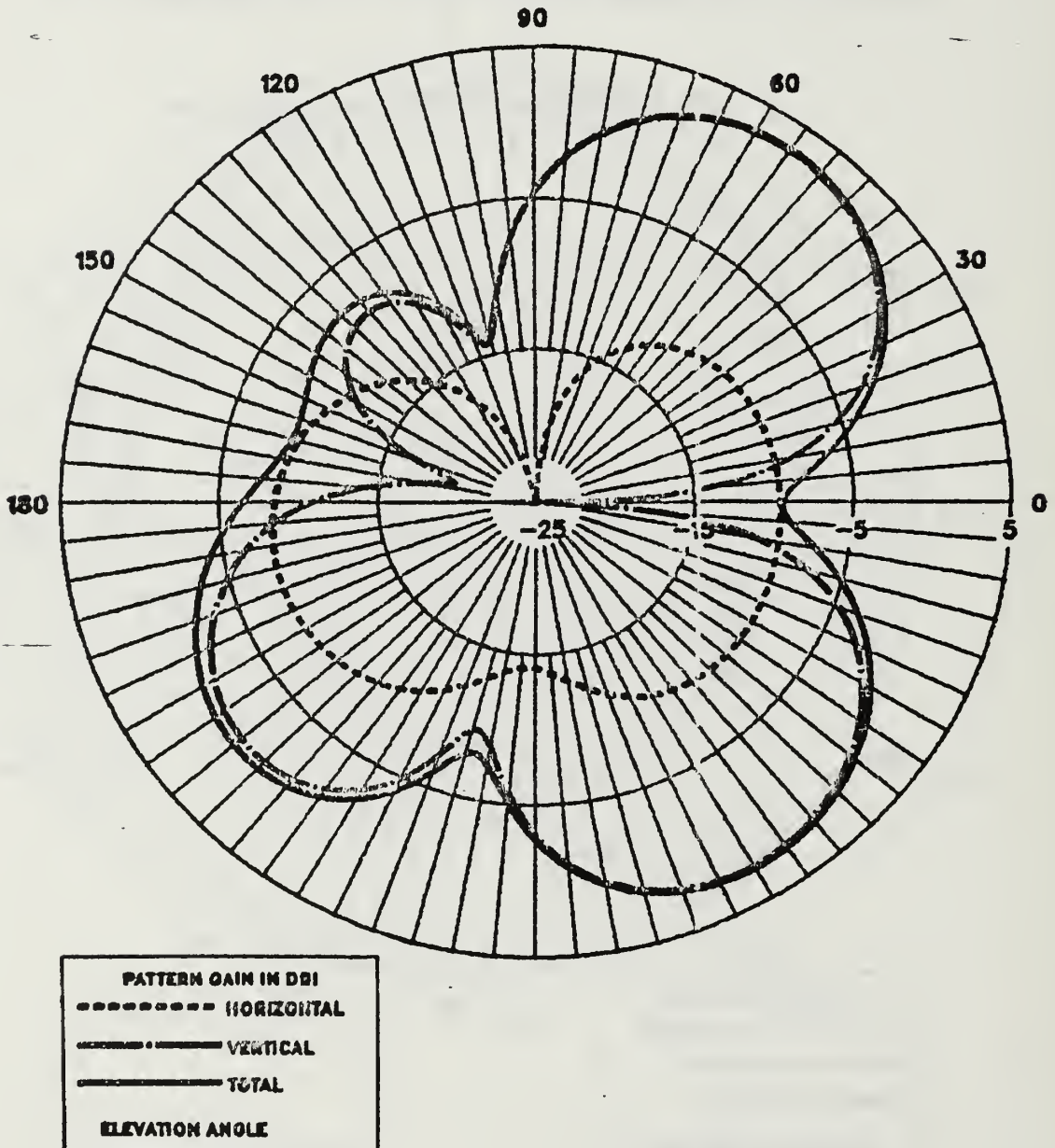
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

CG 437R-2 ANT, FREE SPACE, HORIZ CUT, THETA=26



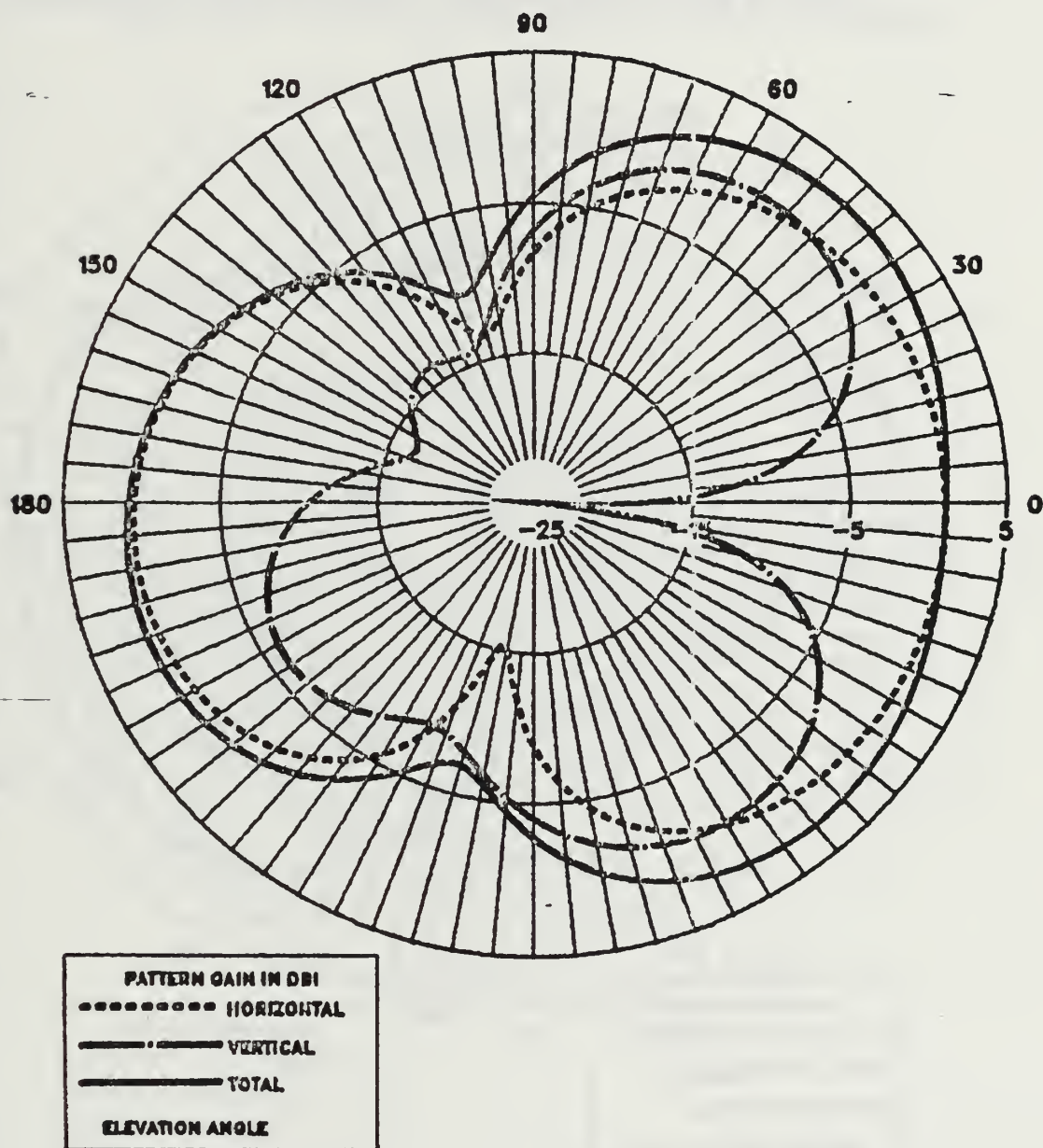
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=0



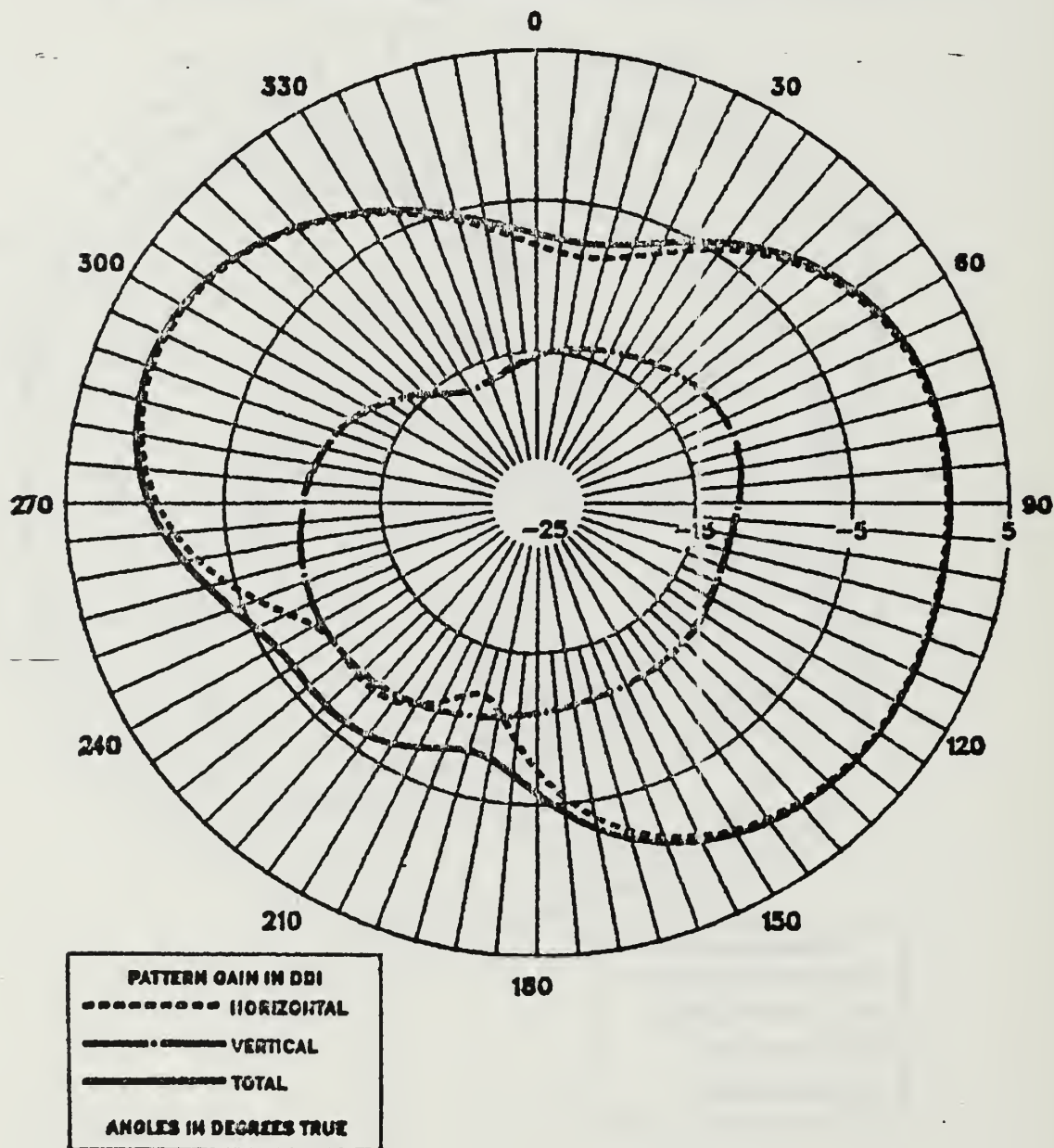
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

CG 437R-2 ANT, FREE SPACE, VERT CUT, PHI=45



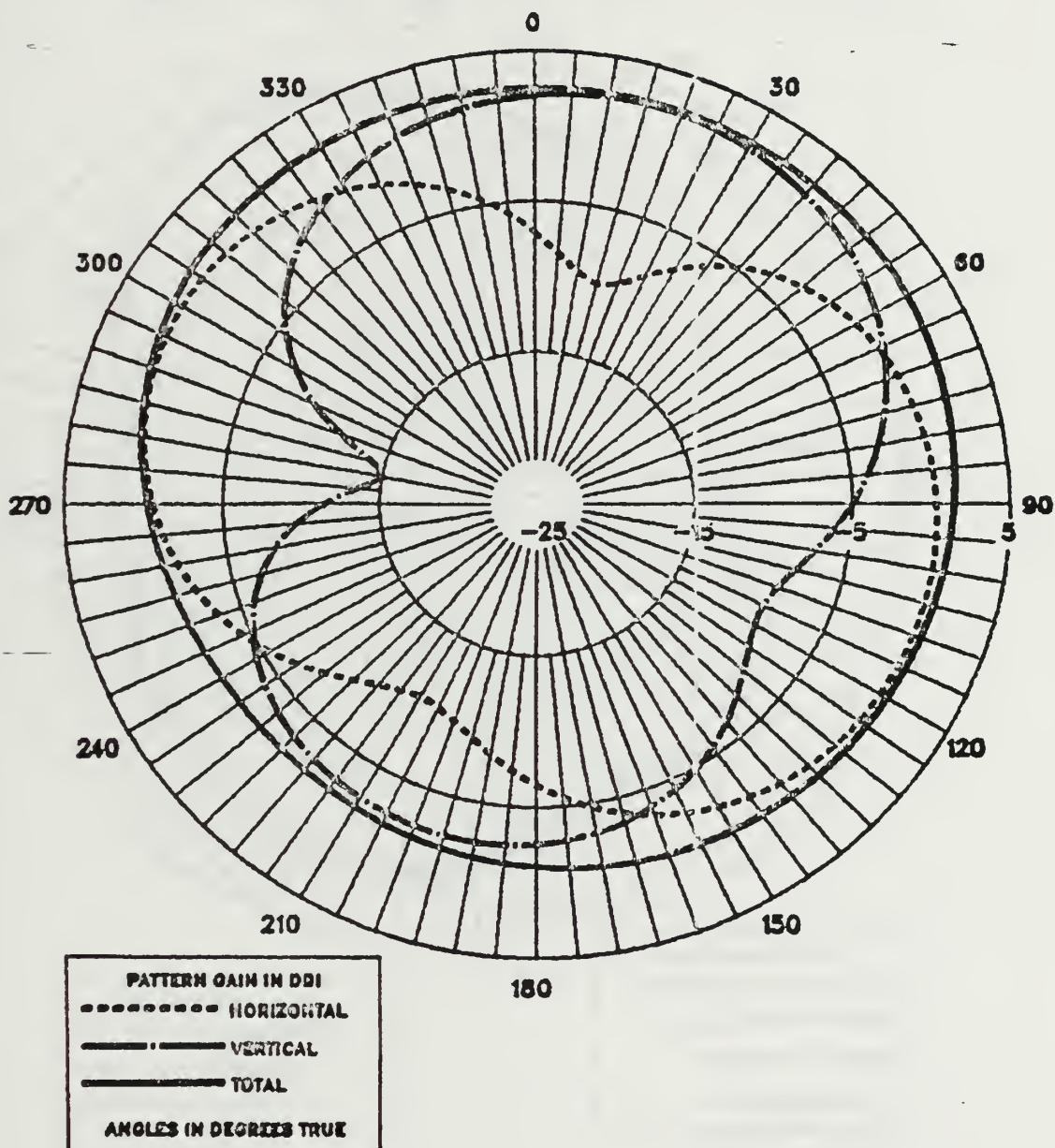
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=90



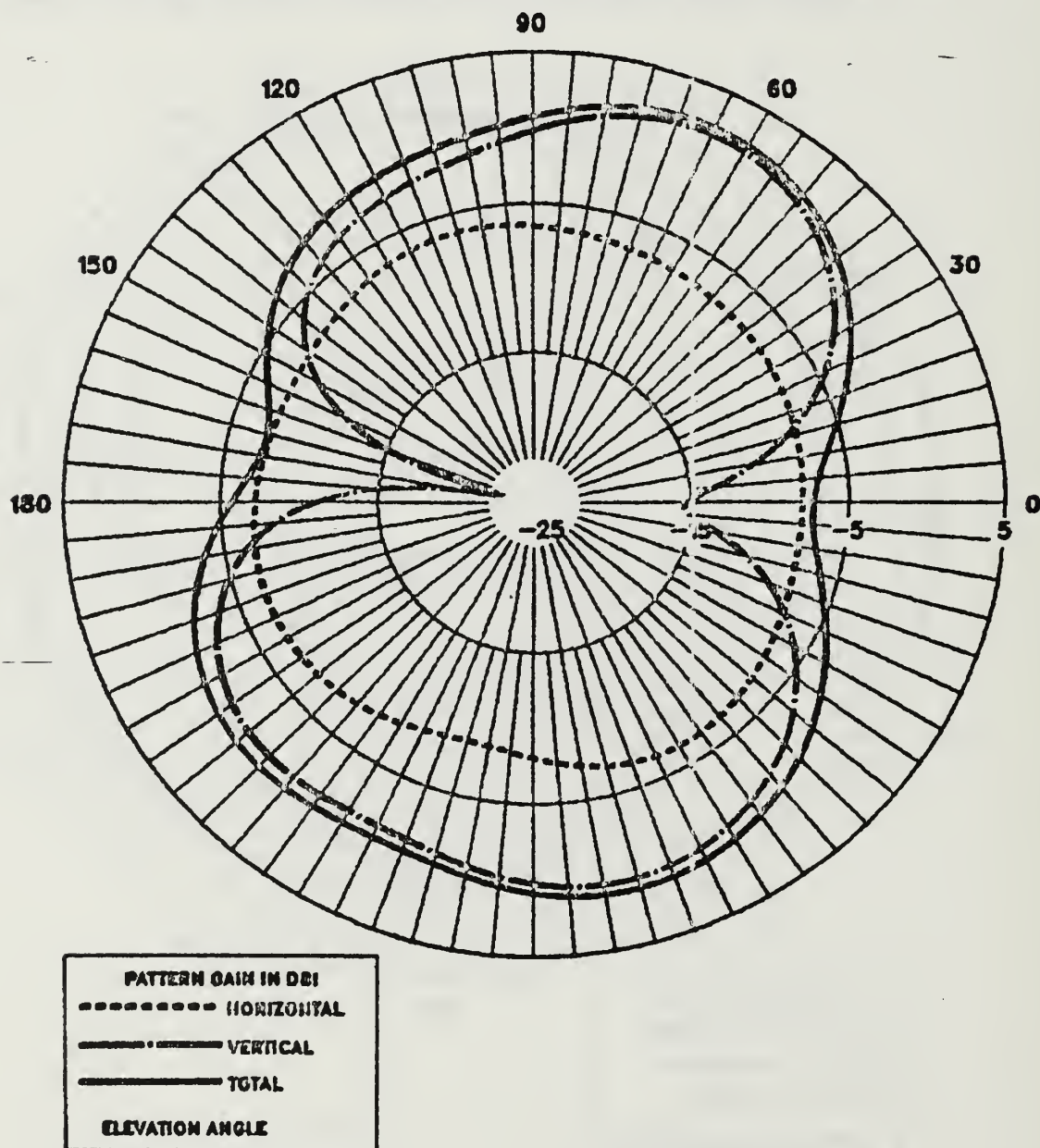
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, HORIZ CUT, THETA=26



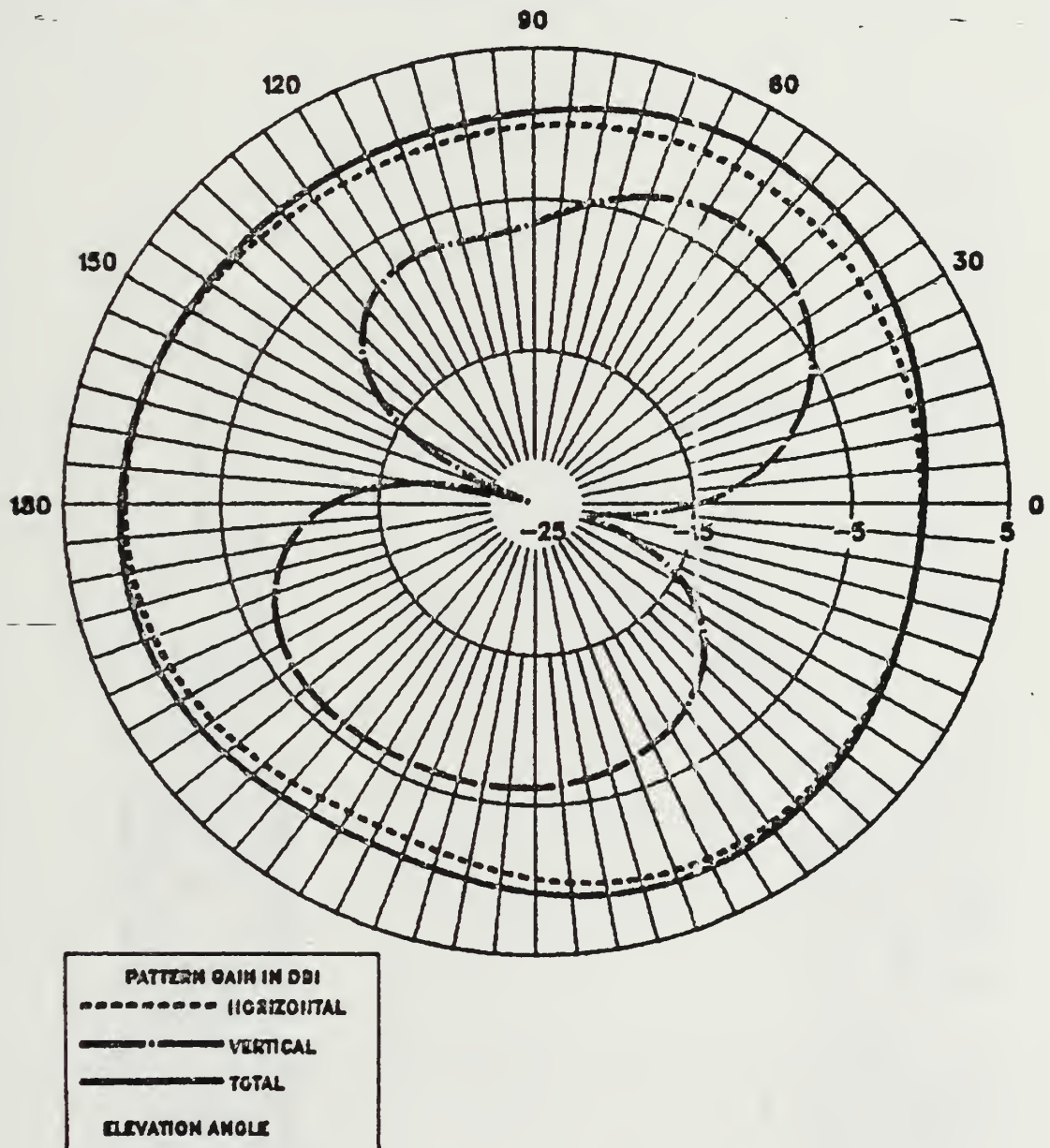
H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, $\Phi=0$



H60 IGUANA DATA RUN AT 18.1MHZ ON 8/22/87

ARMY-TYPE TUBE ANT, FREE SPACE, VERT CUT, PHI=45



APPENDIX B
ADVANCED PROPHET SCENARIO OUTPUT

ADVANCED
PROPHET
SYSTEM

NOSC 72



DEVELOPED AND MAINTAINED BY:
IONOSPHERIC BRANCH CODE 542 (ALGORITHM/MODEL DEVELOPMENT)
(619) 225-2002 / (AUTOVON) 933-2002
SIGNALS EXPLOITATION BRANCH CODE 772 (SYSTEM INTEGRATION)
(619) 225-2924 / (AUTOVON) 933-2924
NAVAL OCEAN SYSTEM CENTER
SAN DIEGO, CA. 92152-5000

[illegible]

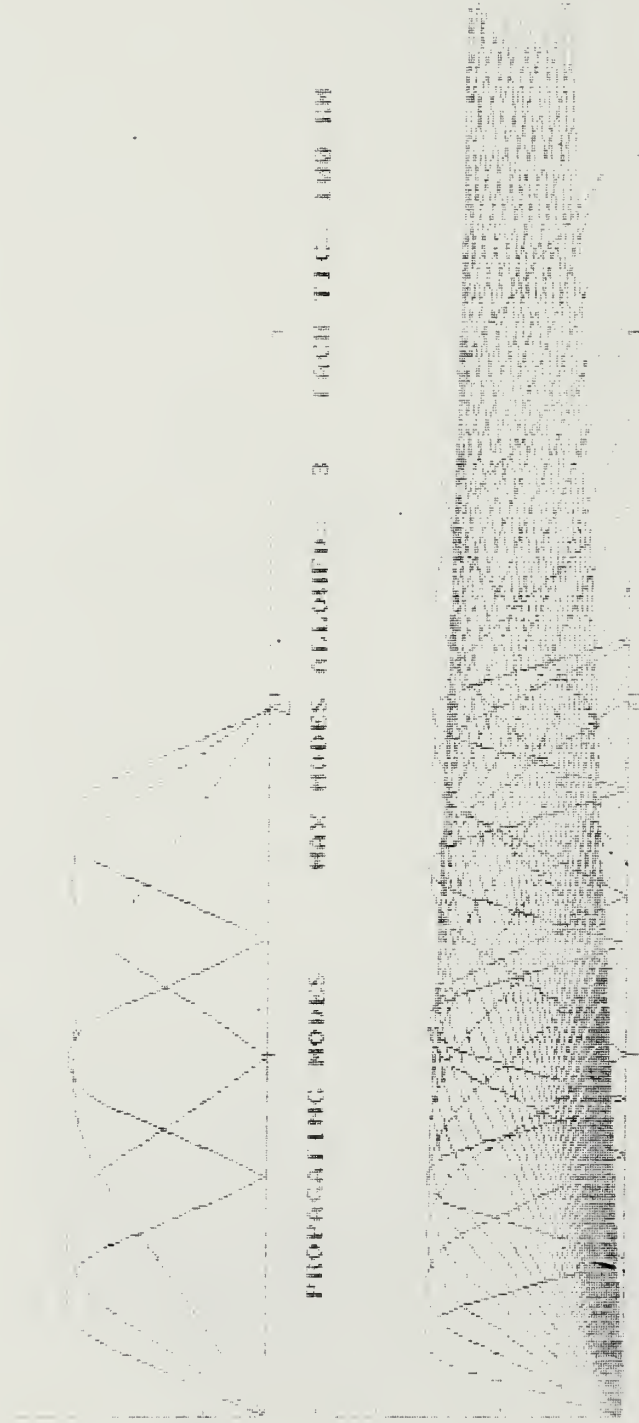
The figure consists of 15 small diagrams labeled (a) through (m), arranged vertically. Each diagram depicts a different stage or aspect of a parasite's life cycle, including eggs, larvae, and adult forms, often showing their interaction with host cells or tissues.

[illegible]


```

NOT UNCLASSIFIED XXX
DATE: 1/1/85 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
MODE: 3.1 500 50.0 Hz: 1.0 NOISE NOISE: 50 SUM MEAN: 12.0 dB
FREQ: 36-40 Hz: 74-80 Hz: 0.0 NOISE: 100.00
MODE: 36-40 Hz: 76-81 Hz: 194 Hz: 1.0 NOISE: 100.00
MODE: 100-1.4 MHz: 1.6 MHz: 100.0 Hz: 3.0
MODE: 350 Hz: 100.0 Hz

```



PROPAGATING MODES MAX MODES ALLOWED: 3 EACH TIC: 100 Hz

NOISE LOUCH ANGLES: 3000 1.000 Hz: 100.0 Hz: 2.000

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO1 36- 0- 0 N 74-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 106.0 NMI
 IONOSPHERE: FOF= .4 MHZ FOF1= .6 MHZ FOF2= 3.3
 HMF2= 350. KM YMF2=100.0 KM

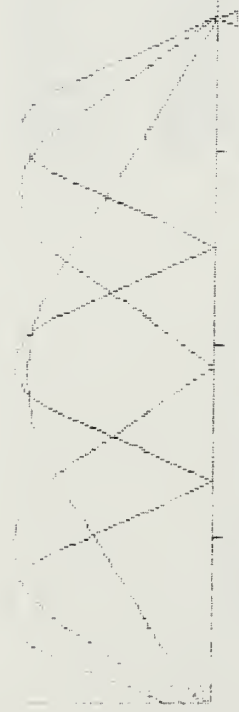
NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	75.70	83.10	85.45	.00	.00	.00
DELAY(MSEC)	2.812	5.792	8.750	.000	.000	.000
LOSS(DB)	100.07	112.90	120.13	.00	.00	.00
GAIN TX/RX	0/-10	0/-10	0/-10	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	50.58	37.74	30.52	.00	.00	.00
ADJ SNR(DB)	16.11	3.27	-3.95	.00	.00	.00
VIR HT1(KM)	411.06	440.01	447.96	.00	.00	.00
VIR HT2(KM)	.00	427.13	437.91	.00	.00	.00
VIR HT3(KM)	.00	.00	429.47	.00	.00	.00

RA>

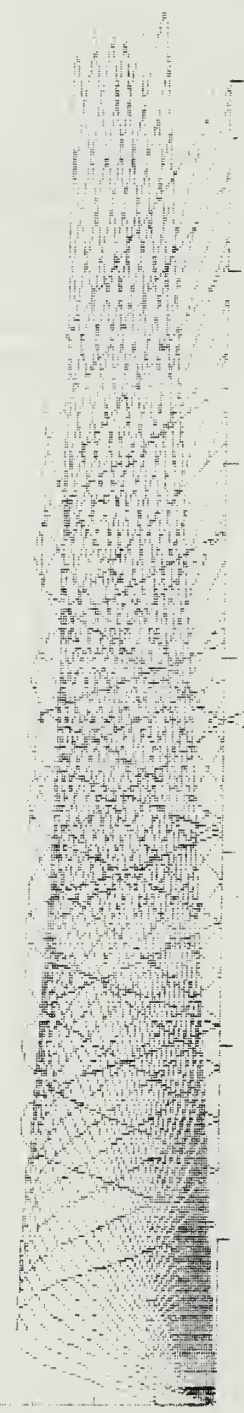
UNCLASSIFIED ***

DTG: 17 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
 REF: 3.1 CSN: 50.0 RP: 1.0 NON-NADE NOISE: 50
 WAVE: HELD 36-0-0 N 72-30-0 H ANT: 0 0 0000000000
 GND: NEOLP 36-40-12 H 75-31-4R H ANT: 149 0 1.5 RANGE: 190.5 NM
 CA SPHERE: FOR: .4 MIZ FOR: .6 MIZ FOR: 3.3
 HNF2: 350. RM YMF2: 100.0 RM

17 1/86 09:00
 190.5 NM



PROPAGATING MODES MAX NODES ALLOWED: 3 EACH TIC: 100 RM



LAUNCH ANGLES: STAFF 1.00 TUD: 07.00 INC: 2.00

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO2 36- 0- 0 N 72-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 198.9 NMI
 IONOSPHERE: FOF= .4 MHZ FOF1= .6 MHZ FOF2= 3.3
 HMF2= 350. KM YMF2=100.0 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	61.85	76.95	81.55	.00	.00	.00
DELAY(MSEC)	2.750	5.787	8.904	.000	.000	.000
LOSS(DB)	99.38	111.88	119.60	.00	.00	.00
GAIN TX/RX	0/-10	0/-10	0/-10	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	51.27	38.77	31.04	.00	.00	.00
ADJ SNR(DB)	16.80	4.30	-3.43	.00	.00	.00
VIR HT1(KM)	367.20	436.29	463.46	.00	.00	.00
VIR HT2(KM)	.00	414.52	440.88	.00	.00	.00
VIR HT3(KM)	.00	.00	424.89	.00	.00	.00
RA>						

1. The first part of the document is a title page. It contains the title "THE HISTORY OF THE UNITED STATES OF AMERICA" and the author "BY JAMES M. SMITH".

2. The second part of the document is a table of contents. It lists the chapters and their corresponding page numbers.

3. The third part of the document is the first chapter, titled "THE DISCOVERY OF AMERICA". It describes the early exploration of the continent by Christopher Columbus and other European navigators.

4. The fourth part of the document is the second chapter, titled "THE SETTLEMENT OF AMERICA". It discusses the early colonial settlements and the challenges faced by the settlers.

5. The fifth part of the document is the third chapter, titled "THE REVOLUTIONARY WAR". It covers the events leading up to the war and the battle of independence.

6. The sixth part of the document is the fourth chapter, titled "THE CONSTITUTION". It explains the formation of the federal government and the principles of the Constitution.

7. The seventh part of the document is the fifth chapter, titled "THE WESTERN EXPANSION". It describes the westward movement of the population and the acquisition of new territories.

8. The eighth part of the document is the sixth chapter, titled "THE CIVIL WAR". It details the conflict between the Union and the Confederacy and its impact on the nation.

9. The ninth part of the document is the seventh chapter, titled "THE RECONSTRUCTION". It discusses the efforts to rebuild the South and the challenges of integrating freed slaves into society.

10. The tenth part of the document is the eighth chapter, titled "THE PRESENT". It provides a summary of the current state of the United States and its future prospects.

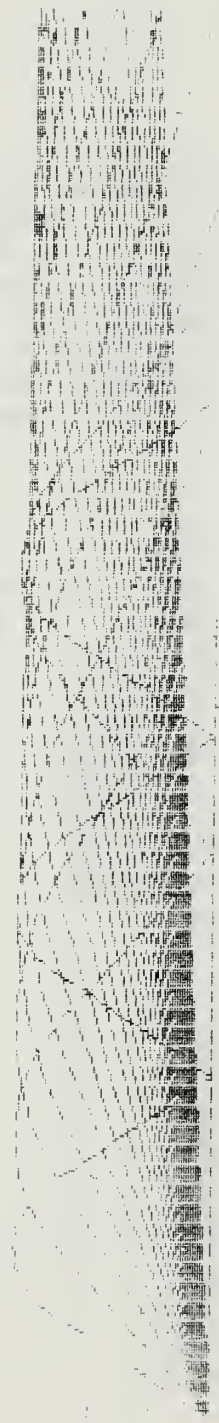
```

DATE: 1/1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
PRF: 3.1 SSN: 50.0 RP: 1.0 MAN-AGE NOISE: SH
UTG: HELO4 36-0-0 N 75-0 W ANT: 9.0 *OMNI*
RCUR: NEOL4 36-40-12 N 75-31-48 W ANT: 182.0 *OMNI*
LOCUS: EOE- .4 MHZ EOFF= .6 MHZ EOFF= 3.
UNIT2= 350. MH UNIT2= 100.0 RT

```



PROPAGATING MODES **HAX MODES ALLOWED:**

[illegible]

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO4 36- 0- 0 N 76- 0- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 182 @ *OMNI* RANGE: 47.7 NMI
 IONOSPHERE: FOF1= .4 MHZ FOF2= .6 MHZ FOF3= 3.3
 HMF2= 350. KM YMF2=100.0 KM

NHOP	1	2	0	0	0	0
MODE	3000000	3300000	0000000	0000000	0000000	0000000
ANGLE	83.70	86.85	.00	.00	.00	.00
DELAY(MSEC)	2.845	5.726	.000	.000	.000	.000
LOSS(DB)	100.83	112.98	.00	.00	.00	.00
GAIN TX/RX	0/-40	0/-40	0/ 0	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	19.57	7.42	.00	.00	.00	.00
ADJ SNR(DB)	-14.90	-27.06	.00	.00	.00	.00
VIR HT1(KM)	426.18	432.68	.00	.00	.00	.00
VIR HT2(KM)	.00	429.01	.00	.00	.00	.00
VIR HT3(KM)	.00	.00	.00	.00	.00	.00

RA>

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 3.123 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 83.49 dB
 REQUIRED POWER: 9.009 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 175.7 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 3.123 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 97.03 dB
 REQUIRED POWER: 202.093 WATTS
 AVAILABLE POWER: 100.000 WATTS
 ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 176.0 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO3 ON: 3.123 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: H
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 192.16 dB
 REQUIRED POWER: 100.000 WATTS
 AVAILABLE POWER: 100.000 WATTS

** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 SIGNIFICANT IMPROVEMENT MAY BE GAINED WITH VERTICAL POLARIZATION.

MAX RANGE FOR POWER OF 100.000 WATTS: 10.8 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW)

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED ***

DATE: 1/ 1 AT 09:00 UT

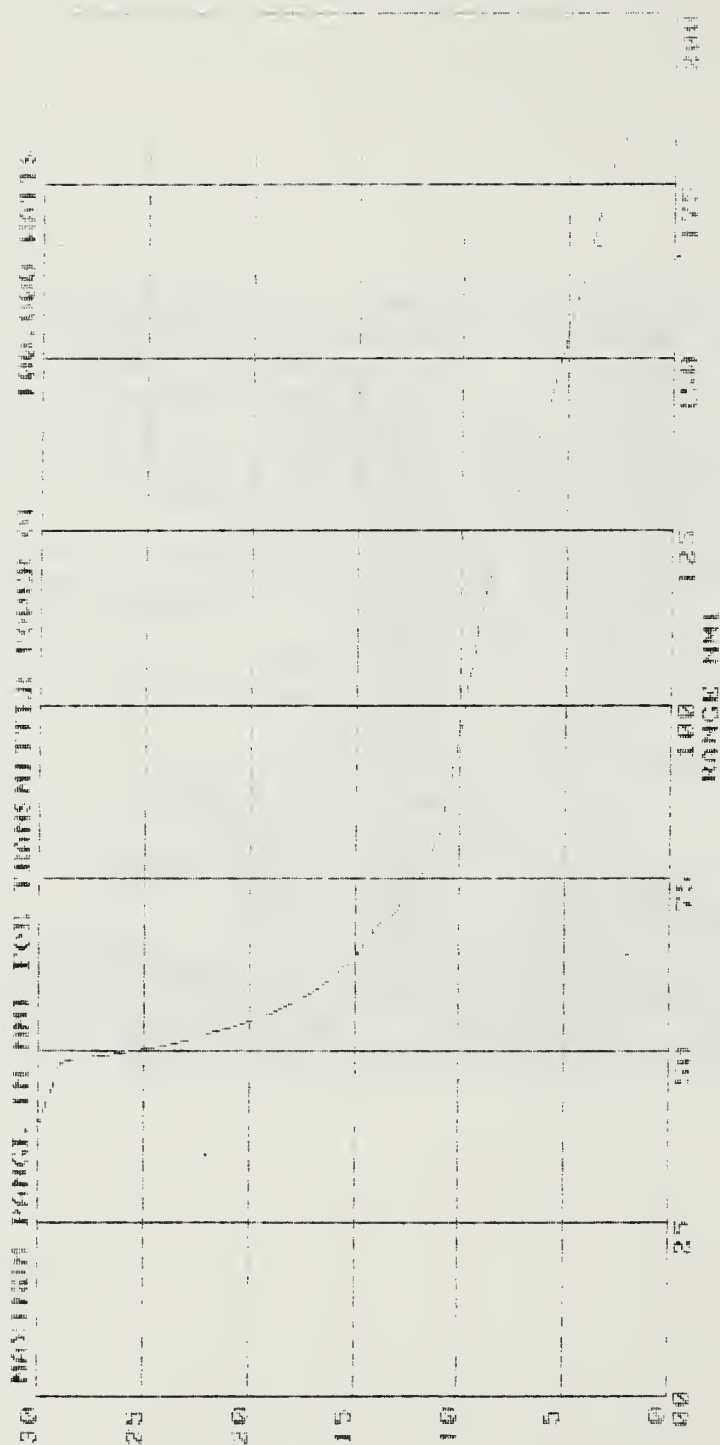
GROUNDWAVE IS FROM HELO4 ON:	3.123 MHZ
RANGE TO RECEIVER NFOLK IS:	47.7 NMI
TRANSMIT GROUNDWAVE GAIN:	.0 dBi
POLARIZATION:	V
TRANSMIT ANTENNA HEIGHT:	500.0 FEET
RECEIVE ANTENNA HEIGHT:	.0 FEET
TRANSMITTER POWER:	100.0 WATTS
REQUIRED BANDWIDTH:	2.8 KHZ
REQUIRED SIGNAL TO NOISE:	12.0 dB
TERRAIN:	SE
SURFACE COVER:	//
SURFACE CONDUCTIVITY:	.40E+01 MHO/M
DIELECTRIC:	81.00
WIND VELOCITY:	25.0 KNOTS
MANMADE NOISE MODEL:	SH
ATMOSPHERIC NOISE:	YES
CALCULATED GROUNDWAVE LOSS:	72.76 dB
REQUIRED POWER:	.766 WATTS
AVAILABLE POWER:	100.000 WATTS

MAX RANGE FOR POWER OF 100.000 WATTS: 175.5 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
GW>

UNCLASSIFIED

GROUNDWAVE ANALYSIS FOR DATE: 1/1/86 TIME: 07:00 H
 STATION: HELIX POLARIZATION: V POWER: 100.000 WATTS
 FREQUENCY: 3.123 MHZ RANGE: 17.7 NM
 ANTENNA HEIGHT: 500.0 FEET ROOF: 1.8 FEET
 WIND: 25 KNOTS ATMOSPHERIC NOISE: VPS
 SURFACE CONDUCTIVITY: 0.0001 MUOM
 BANDWIDTH: 2.000 KHZ MANMADE NOISE: 50



UNCLASSIFIED

11-10-1961

ENCLOSURE NO. 1
 AREA COVERED: 1/2 AC. TIME: 49.00 HR

ENCLOSURE FREQUENCY: 5.70 MHz



PS. 4
 DATE: 10-5-61
 TIME: 10:00 AM
 TOTAL: 49.00 HR

11-10-1961

UNCLASSIFIED ***

DATE: 17 FEB 1966 TIME: 09:00 UT CRYPTOGRAPHIC NOISE: YES
 CHAN: 5.7 SSB: 50.0 RT: 1.0 3000 HART NOISE: SU 3000 HART: 12.0 DB
 CHAN: HELIO 36 00 00 73-30-00 RT: 0 0 000000 000000
 CHAN: HELIO 36-40-12 00 76-31-30 RT: 199 0 1 0 NOISE: 100.0 DB
 COMMENTS: FOF2 = .4 MHZ FOF1 = .6 MHZ FOF2 = 3.2
 FOF2 = 350. RT 3000-1000 0 RT

PROPAGATING MODES MAX MODES ALLOWED 3 EACH FIC 100 KM

ROYTON LAUNCH CIRCLES: START 1000 000 1000 000 1000 000

Figure 1 displays a series of 14 line drawings illustrating the progression of a child's drawing of a person from age 2 to age 10. The drawings are arranged vertically, with the youngest at the top and the oldest at the bottom. The progression shows the development of features like head, torso, limbs, and facial details.

[illegible]

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters.

2. The second part outlines the various methods and tools used to collect and analyze data. This includes both traditional manual methods and modern digital technologies, highlighting the advantages of each approach.

3. The third part focuses on the interpretation of results and the drawing of conclusions. It provides guidelines on how to effectively communicate findings to stakeholders and make informed decisions based on the data.

4. The fourth part addresses the challenges and limitations associated with data collection and analysis. It discusses common pitfalls and offers strategies to overcome them, ensuring the reliability and validity of the results.

5. Finally, the document concludes by summarizing the key points and reiterating the importance of a systematic and rigorous approach to data management and analysis.

1. The first part of the document is a list of references. The references are listed in a standard format, with the author's name, the title of the work, and the publisher. The references are as follows:

1. J. H. Van Veen, *The History of the Netherlands*, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578,

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DATE: 1/1/06 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
CREF: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: NO
SUTR: BELLO 36-0-0 N 76-0-0 W AMT: 0.0 COMNIT* PRR: 100.00
Q UR: NEOLK 35-40 12 N 76-31-48 W AMT: 182.0 COMNIT* RANGE: 47.7 NM
IONOSPHERE: FOF1= .4 MIZ FOF2= .6 MIZ FOF3= 3.3
HME2= 350. KM YMF2=100.0 KM

PROPAGATING MODES MAX MODES ALLOWED= 3 EACH TIC= 100 KM

RAYPATH LAUNCH ANGLES: START= 1.00 END= 87.00 INCL= 2.00

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 5.696 MHZ
 RANGE TO RECETIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 93.53 dB
 REQUIRED POWER: 17.655 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 145.5 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 110.23 dB
 REQUIRED POWER: 821.762 WATTS
 AVAILABLE POWER: 100.000 WATTS
 ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 145.7 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 1/ 1 AT 09:00 UT
GROUNDWAVE IS FROM HELO4 ON: 5.696 MHZ
RANGE TO RECEIVER NFOLK IS: 47.7 NMI
TRANSMIT GROUNDWAVE GAIN: .0 dBi
POLARIZATION: V
TRANSMIT ANTENNA HEIGHT: 500.0 FEET
RECEIVE ANTENNA HEIGHT: .0 FEET
TRANSMITTER POWER: 100.0 WATTS
REQUIRED BANDWIDTH: 2.8 KHZ
REQUIRED SIGNAL TO NOISE: 12.0 dB
TERRAIN: SE
SURFACE COVER: //
SURFACE CONDUCTIVITY: .40E+01 MHO/M
DIELECTRIC: 81.00
WIND VELOCITY: 25.0 KNOTS
MANMADE NOISE MODEL: SH
ATMOSPHERIC NOISE: YES
CALCULATED GROUNDWAVE LOSS: 79.52 dB
REQUIRED POWER: .704 WATTS
AVAILABLE POWER: 100.000 WATTS
MAX RANGE FOR POWER OF 100.000 WATTS: 145.4 NMI
NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
GW>

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AREA COVERAGE I DOIR: 1/1/86 TIME: 10:00 M

TRANSMITTER FREQUENCY: 3.12 MHZ



HFLO4 (S) COVERAGE : X

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1/1/86

UNCLASSIFIED ***

DATE: 17/1/05 TIME: 18:00 UT ATMOSPHERIC NOISE: YES
REQ: 3.1 SSN: 50.0 RP: 1.0 MAN-MADE NOISE: SH SWR RECD: 13.0 DB
CHIR: HELD 36 0-0 N 76-0 0 M ANT: 0 0 MONITOR PWR: 100.00
C9R: NTCOR 36-40-12 N 76-31-40 M ANT: 182 0 MONITOR RANGE: 47.7 NM
ONOSPHERE: FOF2: 3.0 MHZ FOF1: 4.2 MHZ FOF2: 8.6
MUF2: 34.1 KM ZMF2: 119.6 KM

RECEIVED

PROPAGATING MODES MAX MODES ALLOWED: 3 EQUATION: 100 KM

ROYFAM LAUNCH DATES: START 1.00 END: 87 00 UTC: 1.00

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO4 36- 0- 0 N 76- 0- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 182 @ *OMNI* RANGE: 47.7 NMI
 IONOSPHERE: FOF1= 3.0 MHZ FOF2= 4.2 MHZ FOF3= 8.6
 HMF2= 341. KM YMF2=119.6 KM

NHOP	1	2	4	0	0	0
MODE	1000000	2200000	2222000	0000000	0000000	0000000
ANGLE	69.50	82.85	86.40	.00	.00	.00
DELAY(MSEC)	.856	2.436	4.816	.000	.000	.000
LOSS(DB)	133.60	189.60	271.87	.00	.00	.00
GAIN TX/RX	0/-18	0/-40	0/-40	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	9.30	-68.70	EXCESSIVE	.00	.00	.00
ADJ SNR(DB)	-25.17	-103.17	EXCESSIVE	.00	.00	.00
VIR HT1(KM)	120.40	182.03	180.95	.00	.00	.00
VIR HT2(KM)	.00	181.47	180.74	.00	.00	.00
VIR HT3(KM)	.00	.00	180.55	.00	.00	.00

RA>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO4 ON:	3.123 MHZ
RANGE TO RECEIVER NFOLK IS:	47.7 NMI
TRANSMIT GROUNDWAVE GAIN:	.0 dBi
POLARIZATION:	V
TRANSMIT ANTENNA HEIGHT:	500.0 FEET
RECEIVE ANTENNA HEIGHT:	.0 FEET
TRANSMITTER POWER:	100.0 WATTS
REQUIRED BANDWIDTH:	2.8 KHZ
REQUIRED SIGNAL TO NOISE:	12.0 dB
TERRAIN:	SE
SURFACE COVER:	//
SURFACE CONDUCTIVITY:	.40E+01 MHO/M
DIELECTRIC:	81.00
WIND VELOCITY:	25.0 KNOTS
MANMADE NOISE MODEL:	SH
ATMOSPHERIC NOISE:	YES
CALCULATED GROUNDWAVE LOSS:	72.76 dB
REQUIRED POWER:	.681 WATTS
AVAILABLE POWER:	100.000 WATTS

MAX RANGE FOR POWER OF 100.000 WATTS: 179.3 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

$\frac{1}{\sqrt{2}} \begin{pmatrix} 1 & -i \\ 0 & 1 \end{pmatrix}$

Figure 1. Schematic representation of the experimental design. The first part of the study was a pretest in which the effect of the number of items on the number of items recalled was tested. The second part of the study was a main experiment in which the effect of the number of items on the number of items recalled was tested. The third part of the study was a posttest in which the effect of the number of items on the number of items recalled was tested.



1. *Chlorophyll a* (Chl a)
 2. *Chlorophyll b* (Chl b)
 3. *Carotenoids*
 4. *Protein*
 5. *Starch*
 6. *Cellulose*
 7. *Lignin*
 8. *Hemicellulose*
 9. *Pectin*
 10. *Phenolics*
 11. *Silica*
 12. *Calcium*
 13. *Magnesium*
 14. *Potassium*
 15. *Sulfur*
 16. *Phosphorus*
 17. *Nitrogen*
 18. *Carbon*
 19. *Oxygen*
 20. *Hydrogen*

[illegible]

100

[The following text is extremely faint and largely illegible due to extreme blurring and low contrast. It appears to be a list or index of items, possibly related to the botanical specimens shown above.]

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

[illegible]

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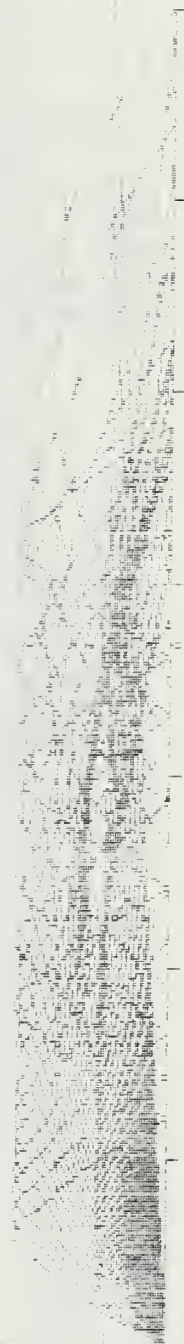
ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO1 36- 0- 0 N 74-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 106.0 NMI
 IONOSPHERE: FOF= 3.0 MHZ FOF1= 4.2 MHZ FOF2= 8.6
 HMF2= 341. KM YMF2=119.5 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	72.40	80.95	83.95	.00	.00	.00
DELAY(MSEC)	2.262	4.368	6.511	.000	.000	.000
LOSS(DB)	121.19	147.74	170.09	.00	.00	.00
GAIN TX/RX	0/-11	0/-13	0/-13	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	36.18	7.64	-14.72	.00	.00	.00
ADJ SNR(DB)	1.71	-26.83	-49.19	.00	.00	.00
VIR HT1(KM)	326.01	325.04	324.96	.00	.00	.00
VIR HT2(KM)	.00	325.75	325.43	.00	.00	.00
VIR HT3(KM)	.00	.00	325.91	.00	.00	.00
RA>						

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THE UNIVERSITY OF CHICAGO

[illegible]

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO2 36- 0- 0 N 72-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 198.9 NMI
 IONOSPHERE: FOF1= 3.0 MHZ FOF2= 4.2 MHZ FOF2= 8.6
 HMF2= 342. KM YMF2=119.5 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	59.85	73.45	78.80	.00	.00	.00
DELAY (MSEC)	2.556	4.505	6.605	.000	.000	.000
LOSS (DB)	125.32	148.93	170.71	.00	.00	.00
GAIN TX/RX	0/ -8	0/-11	0/-11	0/ 0	0/ 0	0/ 0
1HZ SNR (DB)	35.06	8.44	-13.34	.00	.00	.00
ADJ SNR (DB)	.59	-26.03	-47.81	.00	.00	.00
VIR HT1 (KM)	336.82	326.25	325.87	.00	.00	.00
VIR HT2 (KM)	.00	326.41	325.96	.00	.00	.00
VIR HT3 (KM)	.00	.00	326.06	.00	.00	.00

RA>

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DATE: 1/1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES
FREQ: 5.7 SSN: 00.0 RP: 1.0, MAN-MADE NOISE: NO
WIND: BELO 36-0 0 M 76-0-0 0 OUT: 0 0 COMM IN PAR: 108.00
RDR: WFOLK 36-10-12 M 76-31-48 M OUT: 102 0 COMM IN RANGE: 47.7 NM
IONOSPHERE: FOF1 3.0 MHZ FOF2 4.2 MHZ FOF3 8.6
HMF2 311. KM YNF2 119.6 KM

PROPAGATING MODES MAX MODES ALLOWED 3 EACH TIC: 100 KM

RAYFAN LAUNCH ANGLES: START 1.00 DEG BY 0.5 INC: 2.00

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ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 1/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO4 36- 0- 0 N 76- 0- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 182 @ *OMNI* RANGE: 47.7 NMI
 IONOSPHERE: FOF1= 3.0 MHZ FOF2= 4.2 MHZ FOF3= 8.6
 HMF2= 341. KM YMF2=119.6 KM

NHOP	1	2	0	0	0	0
MODE	3000000	3300000	0000000	0000000	0000000	0000000
ANGLE	81.85	85.90	.00	.00	.00	.00
DELAY(MSEC)	2.177	4.323	.000	.000	.000	.000
LOSS(DB)	119.85	147.35	.00	.00	.00	.00
GAIN TX/RX	0/-40	0/-40	0/ 0	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	8.28	-19.23	.00	.00	.00	.00
ADJ SNR(DB)	-26.19	-53.70	.00	.00	.00	.00
VIR HT1(KM)	325.02	324.51	.00	.00	.00	.00
VIR HT2(KM)	.00	325.63	.00	.00	.00	.00
VIR HT3(KM)	.00	.00	.00	.00	.00	.00
RA>						

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 93.53 dB
 REQUIRED POWER: 15.392 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 148.8 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 110.23 dB
 REQUIRED POWER: 721.029 WATTS
 AVAILABLE POWER: 100.000 WATTS

** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 148.8 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO4 ON: 5.696 MHZ

RANGE TO RECEIVER NFOLK IS: 47.7 NMI

TRANSMIT GROUNDWAVE GAIN: .0 dBi

POLARIZATION: V

TRANSMIT ANTENNA HEIGHT: 500.0 FEET

RECEIVE ANTENNA HEIGHT: .0 FEET

TRANSMITTER POWER: 100.0 WATTS

REQUIRED BANDWIDTH: 2.8 KHZ

REQUIRED SIGNAL TO NOISE: 12.0 dB

TERRAIN: SE

SURFACE COVER: //

SURFACE CONDUCTIVITY: .40E+01 MHO/M

DIELECTRIC: 81.00

WIND VELOCITY: 25.0 KNOTS

MANMADE NOISE MODEL: SH

ATMOSPHERIC NOISE: YES

CALCULATED GROUNDWAVE LOSS: 79.52 dB

REQUIRED POWER: .611 WATTS

AVAILABLE POWER: 100.000 WATTS

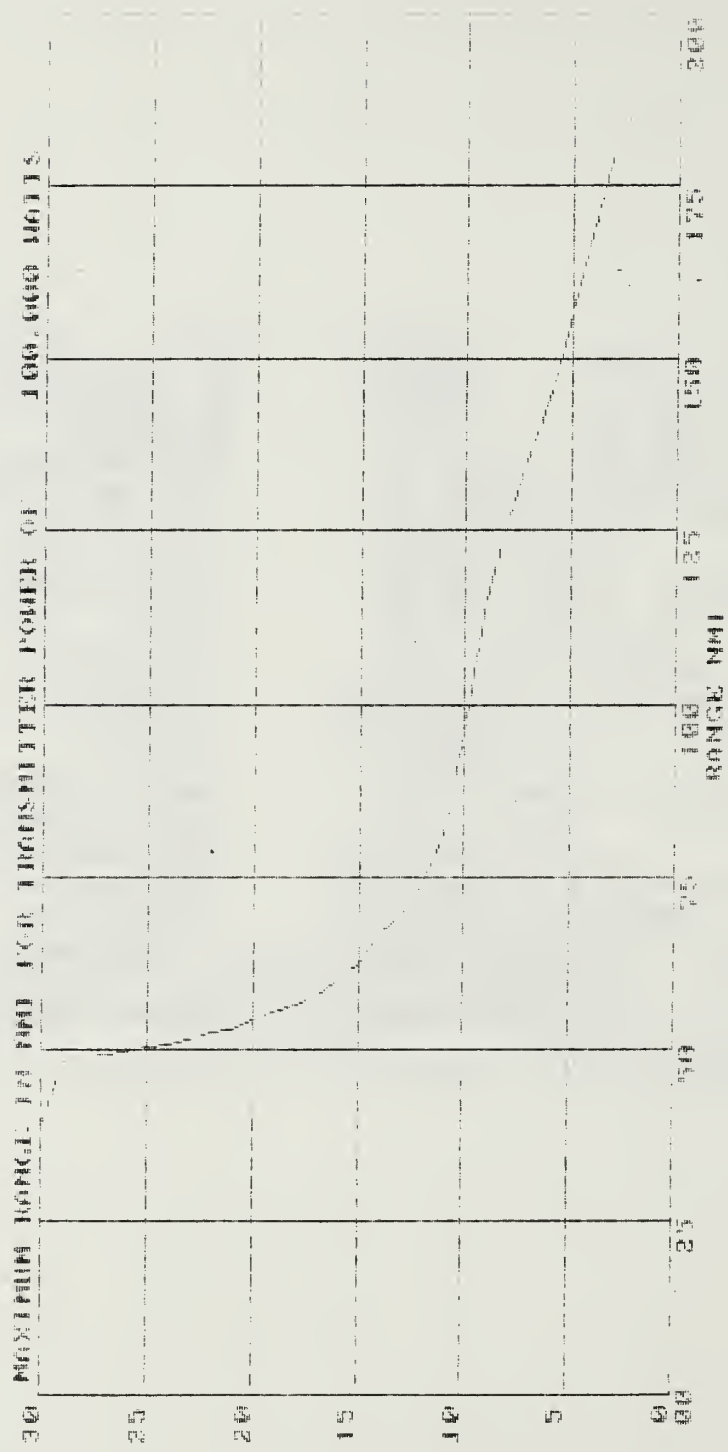
MAX RANGE FOR POWER OF 100.000 WATTS: 148.8 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

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GROUNDWATER ANALYSIS FOR DATE: 11/1/86 TIME: 10:00 HT
 XMITR: HELIX POLARIZATION: 0 POWER: 100.000 WATTS
 RXTR: HELIX FREQUENCY: 5.696 MHZ RANGE: 47.7 NMI
 ANTENNA HEIGHT XMITR: 500.0 FEET RXTR: .0 FEET
 TERRAIN: SE COVER: // WIND: 25.0 KNOTS ATMOSPHERIC NOISE: YES
 DIELECTRIC: 81.0 SURFACE CONDUCTIVITY: .40E+01 MHQ/M
 SPEED SHR: 12.0 DB BANDWIDTH: 2.800 KHZ MONITOR NOISE: 50



F R E Q U E N C Y M H Z

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AREA COVERAGE I DATE: 1/1/86 TIME: 18:49 H

TRANSMITTER FREQUENCY: 8.98 MHz



86.0 LON: WEST 66.0

HEL04 (&) COVERAGE = X

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Figure 1 is a schematic representation of the experimental design. It shows a vertical timeline of events. At the top, 'Pretest' is indicated. Below it, 'Training' is shown with a series of 'Training trials' represented by horizontal bars. A 'Transfer trial' is shown as a single bar. This is followed by 'Test' trials, which are divided into 'Control' and 'Experimental' groups. The 'Control' group shows a 'Control trial' and a 'Control transfer trial'. The 'Experimental' group shows an 'Experimental trial' and an 'Experimental transfer trial'. The timeline ends with 'Posttest'.

[illegible]

$\text{P}(\text{H}_1|\text{E}) = \frac{\text{P}(\text{H}_1) \cdot \text{P}(\text{E}|\text{H}_1)}{\text{P}(\text{H}_1) \cdot \text{P}(\text{E}|\text{H}_1) + \text{P}(\text{H}_2) \cdot \text{P}(\text{E}|\text{H}_2)}$

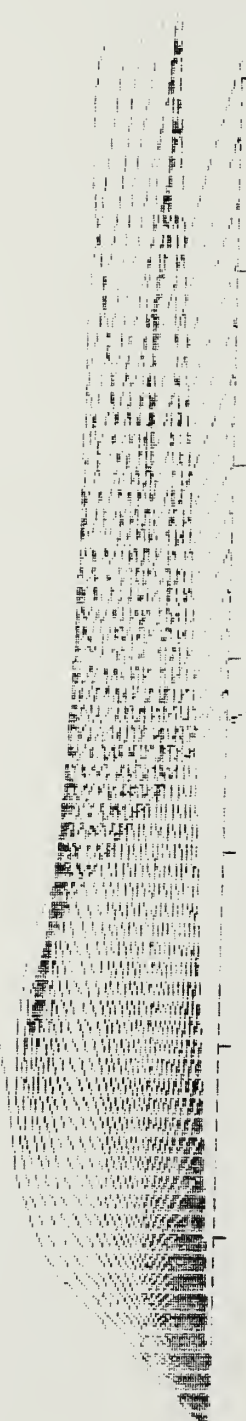
[illegible]

*** UNCLASSIFIED ***

DATE: 1/1/86 TIME: 18:00:00 ATMOSPHERIC NOISE: YES
 CREQ: 9.0 SSN: 50.0 RP: 1.0 MOD MODE NOISE: SH
 QMTR: HELQ2 36-0-0 M 72-30 0 M ONT: 9 0 COMHIT CURE
 QMTR: HELQ2 36-40-12 N 76 31-48 M ONT: 102 0 COMHIT CURE
 IONOSPHERE: FOF2= 1.0 MHz FOF1= 1.2 MHz FOF3= 8.6
 HMF2= 341. KM VMF2= 119.3 KM

PROPAGATING MODES

MAX MODES ALLOWED= 3 EACH 113= 100 KM



RAYFON

LAUNCH ANGLES: START= 1.00 END= 87.00 INC= 2.00

[illegible][illegible]

PROPERLY TUNING MODES MAX MODELS ALLOWED

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 8.984 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 104.59 dB
 REQUIRED POWER: 56.573 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 115.4 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED ***

DATE: 1/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO2 ON: 8.984 MHZ
RANGE TO RECEIVER NFOLK IS: 198.9 NMI
TRANSMIT GROUNDWAVE GAIN: .0 dBi
POLARIZATION: V
TRANSMIT ANTENNA HEIGHT: 500.0 FEET
RECEIVE ANTENNA HEIGHT: .0 FEET
TRANSMITTER POWER: 100.0 WATTS
REQUIRED BANDWIDTH: 2.8 KHZ
REQUIRED SIGNAL TO NOISE: 12.0 dB
TERRAIN: SE
SURFACE COVER: //
SURFACE CONDUCTIVITY: .40E+01 MHO/M
DIELECTRIC: 81.00
WIND VELOCITY: 25.0 KNOTS
MANMADE NOISE MODEL: SH
ATMOSPHERIC NOISE: YES
CALCULATED GROUNDWAVE LOSS: 127.36 dB
REQUIRED POWER: 10712.970 WATTS
AVAILABLE POWER: 100.000 WATTS

— ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **

MAX RANGE FOR POWER OF 100.000 WATTS: 115.4 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW)

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 1/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO4	ON:	8.984 MHZ
RANGE TO RECEIVER NFOLK	IS:	47.7 NMI
TRANSMIT GROUNDWAVE GAIN:		.0 dBi
POLARIZATION:		V
TRANSMIT ANTENNA HEIGHT:		500.0 FEET
RECEIVE ANTENNA HEIGHT:		.0 FEET
TRANSMITTER POWER:		100.0 WATTS
REQUIRED BANDWIDTH:		2.8 KHZ
REQUIRED SIGNAL TO NOISE:		12.0 dB
TERRAIN:		SE
SURFACE COVER:		//
SURFACE CONDUCTIVITY:		.40E+01 MHO/M
DIELECTRIC:		81.00
WIND VELOCITY:		25.0 KNOTS
MANMADE NOISE MODEL:		SH
ATMOSPHERIC NOISE:		YES
CALCULATED GROUNDWAVE LOSS:		86.77 dB
REQUIRED POWER:		.934 WATTS
AVAILABLE POWER:		100.000 WATTS

MAX RANGE FOR POWER OF 100.000 WATTS: 115.4 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

[illegible]

Figure 1 displays 15 numbered line drawings of insects, likely representing different species or morphological variants. The insects are arranged vertically. The first 10 drawings (1-10) are small, elongated insects, possibly flies or beetles, shown from various angles. The next 5 drawings (11-15) are larger, more complex insects, possibly bees or wasps, also shown from various angles. The drawings are simple line art, focusing on the basic shapes and structures of the insects.









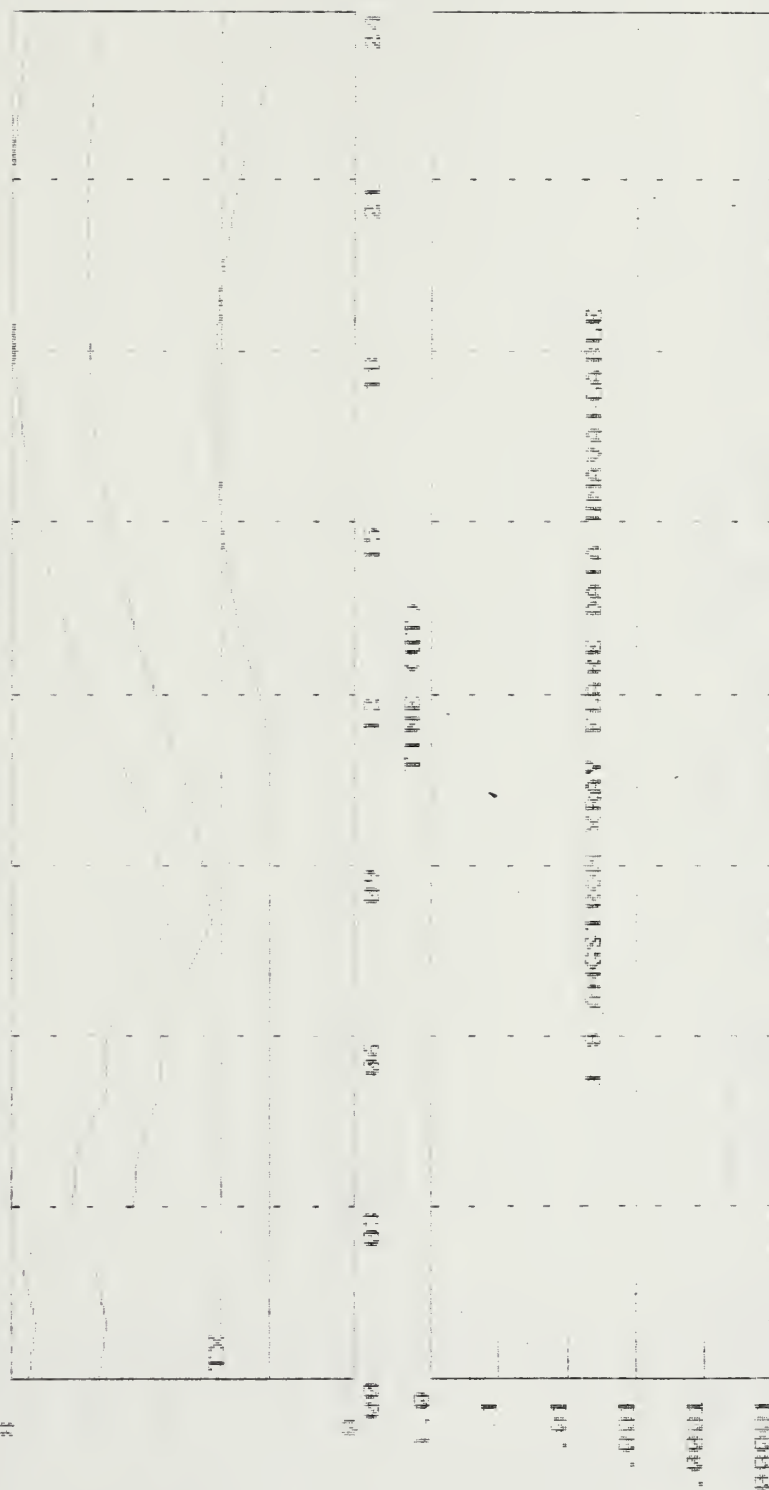



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THE UNIVERSITY OF CHICAGO

[illegible]

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

[illegible]

*** UNCLASSIFIED ***
 NAME: HEL02 36-0-0 H 72-30-0 H 0HT: 0
 CODE: HEOLK 36-40-12 H 76-31-40 H 0HT: 144 RANGE: 198.9 NM
 DATE: 7/1/86 SSN: 590 H RPS: 1.0 1.0 1.0 1.0 1.0 1.0 1.0
 DATA SOURCES: XRAY=DEFAULT RF=DEFAULT SSN=DEFAULT

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*** UNCLASSIFIED ***

XMR: HEL04 36-0-0 N

RCMR: MEOLK 36-40-12 N

DATE: 7/1/86 SSN= 50.0

DATA SOURCES: XRAY=DEFAULT

FREQ: 3.40 MHZ

76-0 0 0 0

76-31-08 4 0MT: 182

RP3= 1.0 1.0 1.0 1.0 1.0 1.0

RP=DEFAULT SSN=DEFAULT

47.7 MHz



TIME (MIN)

1-8 ANGSTROM XRAY FILM DATA UNAVAILABLE

CLARK COLLEGE BOOKS, INC. 1445 OGDEN

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Figure 1. Schematic representation of the experimental design. The subjects were divided into two groups: the control group and the experimental group. The control group received a standard diet and water, while the experimental group received a diet supplemented with 0.5% of the active ingredient. The subjects were then subjected to a 10-week training program. The control group was subjected to a standard training program, while the experimental group was subjected to a training program supplemented with 0.5% of the active ingredient. The subjects were then subjected to a 10-week training program. The control group was subjected to a standard training program, while the experimental group was subjected to a training program supplemented with 0.5% of the active ingredient.

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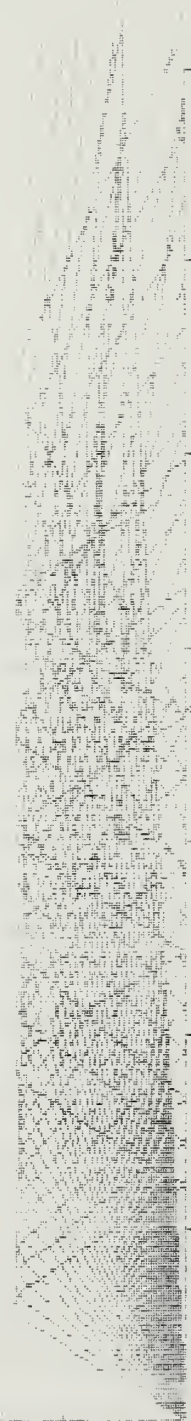
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200 UNCLASSIFIED ***

DATE: 7/1/86 TIME: 09:00 HZ GROUNDWATER NOISE: YES
VIB: 3.1 SSN: 50.0 RP: 1.0 MPT MADE NOISE: NO
VIB: HELIX 36-0-0 HZ 72-30-0 HZ ANT: 4000000 HZ
VIB: HELIX 36-00-12 HZ 72-31-18 HZ ANT: 1490 1.0 NOISE: 198.9 HZ
GROUNDS: FOF: 1.1 HZ FOF: 1.0 HZ FOF: 4 3
VIB: 350. HZ VIB: 102.5 HZ



THROUGATING NOISE MAX NOISE RELATIVE: 3 EACH TIC: 100 HZ



NOISE LOUDEST NOISE: 1.00 HZ 17.00 HZ 2.00

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
XMTR: HELO2 36- 0- 0 N 72-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 198.9 NMI
IONOSPHERE: FOF= 1.1 MHZ FOF1= 1.6 MHZ FOF2= 4.4
HMF2= 350. KM YMF2=102.5 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	58.55	73.45	78.90	.00	.00	.00
DELAY(MSEC)	2.464	4.520	6.680	.000	.000	.000
LOSS(DB)	100.75	111.05	117.88	.00	.00	.00
GAIN TX/RX	0/-10	0/-10	0/-10	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	47.14	36.84	30.01	.00	.00	.00
ADJ SNR(DB)	12.67	2.37	-4.46	.00	.00	.00
VIR HT1 (KM)	318.94	327.98	330.85	.00	.00	.00
VIR HT2 (KM)	.00	324.94	328.79	.00	.00	.00
VIR HT3 (KM)	.00	.00	326.92	.00	.00	.00

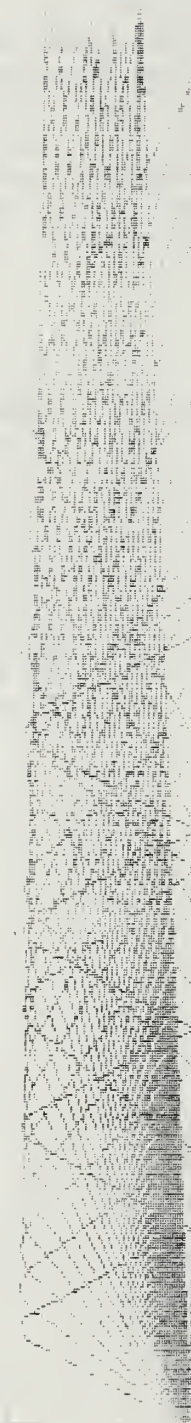
RA>

UNCLASSIFIED

DATE: 7/1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
 FREQ: 3.1 MHz 50.0 Hz 1.0 dB ABOVE NOISE: SNR 12.0 dB
 PATH: 06101 36-0-0 N 73-30 W 0.0 dB: 0.0 dB: 100.0 dB
 ACQU: MEOLK 36-40-12 N 76-31 W 0.0 dB: 1.5 dB: 100.0 dB
 COMMENTS: FOC= 1.1 MHz FOF= 1.6 MHz FOF2= 2.0 MHz
 HNF2= 350. Hz VHF2= 102.4 Hz



PROPAGATING MODES MAX MODES ALLOWED: 3 FREQ FID= 100 Hz



RAYEON LAUNCH ANGLES: START= 1.00 FID= 0.00 FID= 2.00

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
FREQ: 3.1 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
XMTR: HELO1 36- 0- 0 N 74-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 106.0 NMI
IONOSPHERE: FOF= 1.1 MHZ FOF1= 1.6 MHZ FOF2= 4.4
HMF2= 350. KM YMF2=102.4 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	72.30	81.05	84.00	.00	.00	.00
DELAY(MSEC)	2.261	4.421	6.603	.000	.000	.000
LOSS(DB)	99.23	110.94	117.98	.00	.00	.00
GAIN TX/RX	0/-10	0/-10	0/-10	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	48.66	36.95	29.91	.00	.00	.00
ADJ SNR(DB)	14.19	2.48	-4.56	.00	.00	.00
VIR HT1(KM)	324.54	329.30	330.22	.00	.00	.00
VIR HT2(KM)	.00	327.55	329.13	.00	.00	.00
VIR HT3(KM)	.00	.00	328.08	.00	.00	.00
RA>						

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 3.0 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO4 36- 0- 0 N 76- 0- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 182 @ *OMNI* RANGE: 47.7 NMI
 IONOSPHERE: FOF1= 1.1 MHZ FOF2= 1.6 MHZ FOF3= 4.4
 HMF2= 350. KM YMF2=102.3 KM

NHOP	1	2	0	0	0	0
MODE	3000000	3300000	0000000	0000000	0000000	0000000
ANGLE	81.80	85.90	.00	.00	.00	.00
DELAY(MSEC)	2.170	4.318	.000	.000	.000	.000
LOSS(DB)	98.37	110.40	.00	.00	.00	.00
GAIN TX/RX	0/-40	0/-40	0/ 0	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	18.81	6.78	.00	.00	.00	.00
ADJ SNR(DB)	-15.66	-27.69	.00	.00	.00	.00
VIR HT1(KM)	322.98	324.06	.00	.00	.00	.00
VIR HT2(KM)	.00	323.39	.00	.00	.00	.00
VIR HT3(KM)	.00	.00	.00	.00	.00	.00

RA>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 3.123 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 83.49 dB
 REQUIRED POWER: 14.832 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 160.1 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 3.123 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 97.03 dB
 REQUIRED POWER: 288.807 WATTS
 AVAILABLE POWER: 100.000 WATTS

** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 164.8 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

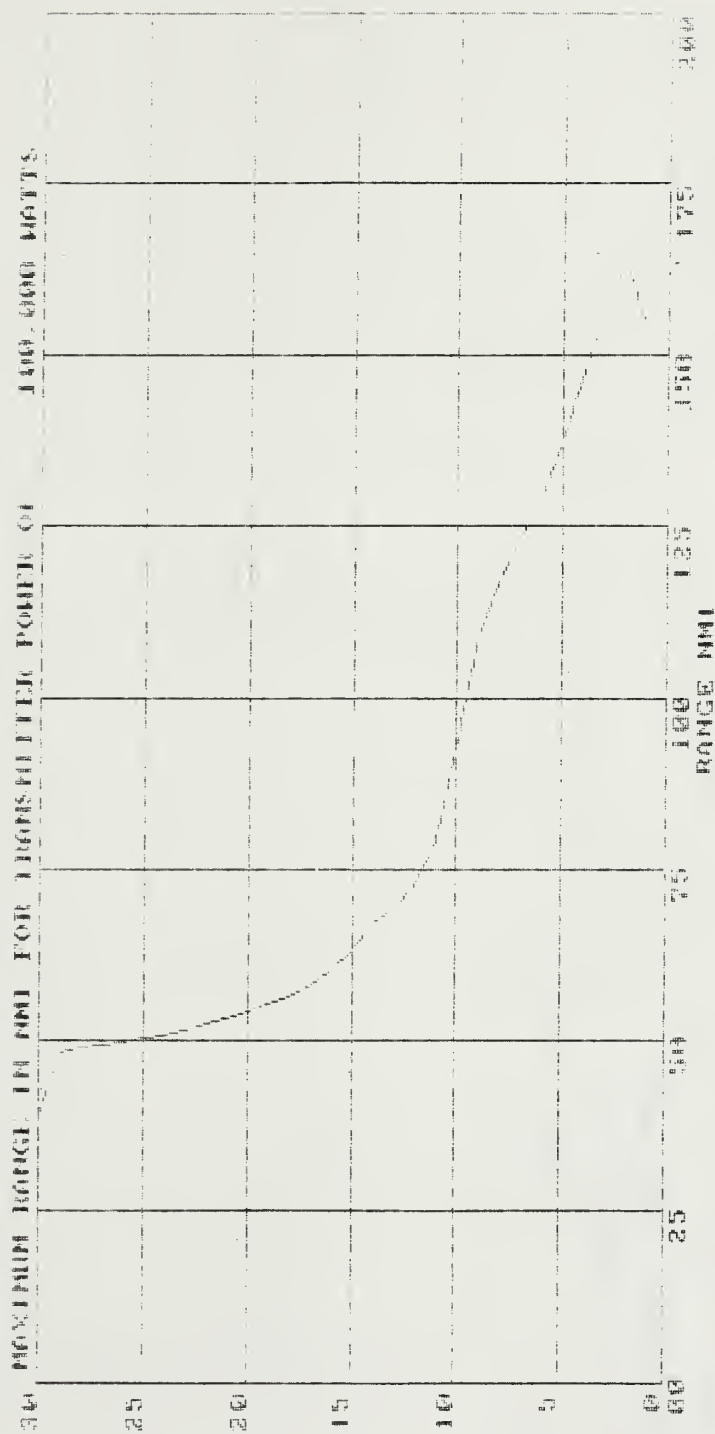
SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT
GROUNDWAVE IS FROM HELO4 ON: 3.000 MHZ
RANGE TO RECEIVER NFOLK IS: 47.7 NMI
TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
TRANSMIT ANTENNA HEIGHT: 500.0 FEET
RECEIVE ANTENNA HEIGHT: .0 FEET
TRANSMITTER POWER: 100.0 WATTS
REQUIRED BANDWIDTH: 2.8 KHZ
REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
CALCULATED GROUNDWAVE LOSS: 72.41 dB
 REQUIRED POWER: 1.450 WATTS
 AVAILABLE POWER: 100.000 WATTS
MAX RANGE FOR POWER OF 100.000 WATTS: 157.5 NMI
NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
GW>

*** UNCLASSIFIED ***

CHCINDUAVE ANALYSIS FOR DATE: 74 1/86 TIME: 09:00 UT
 XMTFR: HELIX POLARIZATION: 0 POWER: 100.000 WATTS
 RCUR: HEOLK FREQUENCY: 3.000 MHZ RANGE: 47.7 NM
 ANTENNA HEIGHT XMTFR: 500.0 FEET RCUR: .0 FEET
 TARRAIN: SE COVER: // WIND: 25.0 KNOTS ATMOSPHERIC NOISE: YES
 DIELECTRIC: 81.0 SURFACE CONDUCTIVITY: .40E+01 MUOM
 REED SNR: 12.0 DB BANDWIDTH: 2.800 KHZ MOHMADE NOISE: SH



THE DOG

[illegible]

Figure 1: Schematic representation of the experimental design. The figure is divided into two main sections: 'Pretest' and 'Main Experiment'. The 'Pretest' section includes a 'Pretest' box with a 'Pretest' label and a 'Pretest' box with a 'Pretest' label. The 'Main Experiment' section includes a 'Main Experiment' box with a 'Main Experiment' label and a 'Main Experiment' box with a 'Main Experiment' label.

THE HISTORY OF THE UNITED STATES

*** UNCLASSIFIED ***

AREA COVERAGE I DATE: 7/1/16 TIME: 09:10 UT

TRANSMITTER FREQUENCY: 5.70 MHz



85.0

LON: WEST

56.0

HELIX (X) COVERAGE - X

XXXXXXXXXX

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UNCLASSIFIED

REF: 7/1/86 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
SSN: 50.0 RP: 1.0 MAX WAVE NOISE: 50 SIN RPD: 12.0 dB
SSN: 36-0-0 74-30 0 4 000: 0 0 0000000000: 100.000
SSN: 36-00-12 76-31 00 4 000: 100 0 1.5 RANGE: 100.0 000
ATMOSPHERE: FOF1 1.6 MHz FOF2: 4.8
MUF3000: 350.0 M YPFL=100.6 RM

PROPAGATING MODES MAX MODES ALLOWED: 4 EACH FREQ 100 RM

RAYON LOUDED AMPLIES: 5000 1.000 0000 000 000 000

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DATE: 7/1/85 TIME: 09:00 UT ATMOSPHERIC NOISE: YES
REQD: 5.7 SSN: 50.0 RP: 1.0 MAN MADE NOISE: SH
CHTR: HELOC 36-0-0 N 76-0-0 ANT: 0 P 0 PH41 K AIR: 12.0 DB
7293: NEOLK 36-40-12 N 75-31-48 W ANT: 103.0 MHz FREQ: 103.00
INDS: PHERE: FOF2= 1.1 MHZ FOF1= 1.6 MHZ FOF2= 4.1
UMR2= 350. KM UMR3= 102.3 KM

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PROPAGATING MODES      MAX MODES ALLOWED= 3      EACH FREQ = 1.00 MHz
```

1. **Introduction**
 2. **Background**
 3. **Methodology**
 4. **Results**
 5. **Discussion**
 6. **Conclusion**
 7. **References**
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 217. **Figure 209**

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 93.53 dB
 REQUIRED POWER: 29.126 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 133.7 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 110.23 dB
 REQUIRED POWER: 1222.074 WATTS
 AVAILABLE POWER: 100.000 WATTS
 ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 136.3 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 7/ 1 AT 09:00 UT

GROUNDWAVE IS FROM HELO4	ON:	5.696 MHZ
RANGE TO RECEIVER NFOLK	IS:	47.7 NMI
TRANSMIT GROUNDWAVE GAIN:		.0 dBi
POLARIZATION:		V
TRANSMIT ANTENNA HEIGHT:		500.0 FEET
RECEIVE ANTENNA HEIGHT:		.0 FEET
TRANSMITTER POWER:		100.0 WATTS
REQUIRED BANDWIDTH:		2.8 KHZ
REQUIRED SIGNAL TO NOISE:		12.0 dB
TERRAIN:		SE
SURFACE COVER:		//
SURFACE CONDUCTIVITY:		.40E+01 MHO/M
DIELECTRIC:		81.00
WIND VELOCITY:		25.0 KNOTS
MANMADE NOISE MODEL:		SH
ATMOSPHERIC NOISE:		YES
CALCULATED GROUNDWAVE LOSS:		79.52 dB
REQUIRED POWER:		1.259 WATTS
AVAILABLE POWER:		100.000 WATTS
MAX RANGE FOR POWER OF	100.000 WATTS:	131.7 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

SECRET

*** UNCLASSIFIED ***
 AREA COVERAGE 1 DATE: 7/1/86 TIME: 18:00 UT
 TRANSMITTER FREQUENCY: 5.74 MHz



46.4 46.44
 LOFT POWER
 46.4 46.44

HELO1 (H1) = ✓ HELO2 (H2) = ✓ BOTH = X

UNCLASSIFIED FOR

1 AREA COVERAGE 1 DATE: 7/1/86 TIME: 18:00 UT

TRANSMITTER FREQUENCY: 5.79 MHZ



05.0 LON: WEST 56.4

06.0 (a) COVERAGE = X

07.0 (b) COVERAGE = X

08.0

ENCLOSURE

REF: 7/1/66 TIME: 10:00 HZ: 100.000 NOISE: YES
TIME: 5.7 SSN: 30.0 EP: 1.0 NON-MODE NOISE: SH SHR REQD: 12.0 DB
MODE: HELIX 36-0 0 H 14-30-0 H OUT: 0 P 3000000 MHz: 100.000
MODE: HELIX 36-40 12 H 16-31-00 H OUT: 144 P 1.5 RANGE: 106.0 MHz
CONSPHERE: FOF2 3.5 MHz FOF1 4.9 MHz FOF2 7.5
MODE: 250. MHz MODE: 119.5 MHz

PROPAGATING MODES

MAX MODES ALLOWED

FOF1 FOF2 FOF3 FOF4

RAYFAN

LAUNCH MODES: START

FOF1 FOF2 FOF3 FOF4

2.400

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO1 36- 0- 0 N 74-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 106.0 NMI
 IONOSPHERE: FOF= 3.5 MHZ FOF1= 4.9 MHZ FOF2= 7.5
 HMF2= 253. KM YMF2=119.8 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	65.30	77.55	81.70	.00	.00	.00
DELAY(MSEC)	1.619	3.144	4.703	.000	.000	.000
LOSS(DB)	119.51	146.65	169.86	.00	.00	.00
GAIN TX/RX	0/-11	0/-11	0/-13	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	37.84	10.70	-14.51	.00	.00	.00
ADJ SNR(DB)	3.37	-23.77	-48.98	.00	.00	.00
VIR HT1(KM)	222.03	231.26	233.63	.00	.00	.00
VIR HT2(KM)	.00	230.93	233.40	.00	.00	.00
VIR HT3(KM)	.00	.00	233.20	.00	.00	.00
RAJ						

UNCLASSIFIED ***

DATE: 7/1/86 TIME: 18:00 UT ATMOSPHERE: NOISE: YES
 UHF: 5.7 SSN: 50.0 RP: 1.0 HHN HHN NOISE: 50 SHR HEAD: 12.0 MM
 FMR: HELO2 36-0-0 H 72-30-0 H AUT: 0 0 000000 PMR: 100.00
 HGR: NEOL2 36-40-12 N 76-31-40 W AUT: 149 0 1.0 RANGE: 198.9 MM
 ATMOSPHERE: FOF2= 3.5 MHz FOF1= 4.0 MHz FOF3= 7.5
 HMF2= 253. KM VHF2= 119.7 MM



PROPAGATING MODES MAX MODES ALLOWED: 3 EACH TIC: 100 KM



RAYFAN LAUNCH ANGLES: START: 1.00 END: 27.00 DEG: 2.000

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO2 36- 0- 0 N 72-30- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 144 @ 1.5 RANGE: 198.9 NMI
 IONOSPHERE: FOF= 3.5 MHZ FOF1= 4.9 MHZ FOF2= 7.5
 HMF2= 253. KM YMF2=119.7 KM

NHOP	1	1	1	0	0	0
MODE	1000000	1000000	2000000	0000000	0000000	0000000
ANGLE	29.90	36.80	44.45	.00	.00	.00
DELAY (MSEC)	1.443	1.537	1.768	.000	.000	.000
LOSS (DB)	135.38	149.81	123.57	.00	.00	.00
GAIN TX/RX	0/-10	0/ -8	0/ -8	0/ 0	0/ 0	0/ 0
1HZ SNR (DB)	22.98	10.55	36.79	.00	.00	.00
ADJ SNR (DB)	-11.49	-23.92	2.32	.00	.00	.00
VIR HT1 (KM)	110.53	140.81	188.80	.00	.00	.00
VIR HT2 (KM)	.00	.00	.00	.00	.00	.00
VIR HT3 (KM)	.00	.00	.00	.00	.00	.00
RA>						

*** UNCLASSIFIED ***

DATE: 7/1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES
 SSN: 50.0 RP: 1.9 HAM MODE NOISE: ON
 HELIX: 36 9-0 N 76-0-0 W ANT: 0 0 WOHM 14
 NEOLK 36 10-12 N 76-31-48 W ANT: 100 0 WOHM 14
 TONSHERE: FREQ: 3.5 MHz FOF2: 1.9 MHz FOF3: 2.7
 HNF2: 253. KM VMEP: 113.3 KM

SWR REFL: 12.0 DB
 PWR: 193.00
 RANGE: 47.7 NM



PROPAGATING MODES MAX MODES ALLOWED: 3 CALL TIME: 100 KM

ROYFALL LAUNCH ANGLES: START 1.00 END 0.00 INCL 0.00

*** UNCLASSIFIED ***

ADVANCED PROPHET RAYTRACE SYNOPSIS

DATE: 7/ 1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES BWIDTH: 2.800 KHZ
 FREQ: 5.7 SSN: 50.0 KP: 1.0 MAN-MADE NOISE: SH SNR REQD: 12.0 DB
 XMTR: HELO4 36- 0- 0 N 76- 0- 0 W ANT: 0 @ *OMNI* PWR: 100.00
 RCVR: NFOLK 36-40-12 N 76-31-48 W ANT: 182 @ *OMNI* RANGE: 47.7 NMI
 IONOSPHERE: FOF= 3.5 MHZ FOF1= 4.9 MHZ FOF2= 7.5
 HMF2= 253. KM YMF2=119.8 KM

NHOP	1	2	3	0	0	0
MODE	3000000	3300000	3330000	0000000	0000000	0000000
ANGLE	78.80	84.40	86.30	.00	.00	.00
DELAY(MSEC)	1.569	3.129	4.691	.000	.000	.000
LOSS(DB)	117.78	146.13	169.58	.00	.00	.00
GAIN TX/RX	0/-18	0/-40	0/-40	0/ 0	0/ 0	0/ 0
1HZ SNR(DB)	32.33	-18.03	-41.47	.00	.00	.00
ADJ SNR(DB)	-2.14	-52.50	-75.94	.00	.00	.00
VIR HT1(KM)	231.61	234.27	234.80	.00	.00	.00
VIR HT2(KM)	.00	234.21	234.75	.00	.00	.00
VIR HT3(KM)	.00	.00	234.69	.00	.00	.00

RA>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 93.53 dB
 REQUIRED POWER: 15.454 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 148.7 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 5.696 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 110.23 dB
 REQUIRED POWER: 723.544 WATTS
 AVAILABLE POWER: 100.000 WATTS
 ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 148.8 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED ***

DATE: 7/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO4 ON: 5.696 MHZ

RANGE TO RECEIVER NFOLK IS: 47.7 NMI

TRANSMIT GROUNDWAVE GAIN: .0 dBi

POLARIZATION: V

TRANSMIT ANTENNA HEIGHT: 500.0 FEET

RECEIVE ANTENNA HEIGHT: .0 FEET

TRANSMITTER POWER: 100.0 WATTS

REQUIRED BANDWIDTH: 2.8 KHZ

REQUIRED SIGNAL TO NOISE: 12.0 dB

TERRAIN: SE

SURFACE COVER: //

SURFACE CONDUCTIVITY: .40E+01 MHO/M

DIELECTRIC: 81.00

WIND VELOCITY: 25.0 KNOTS

MANMADE NOISE MODEL: SH

ATMOSPHERIC NOISE: YES

CALCULATED GROUNDWAVE LOSS: 79.52 dB

REQUIRED POWER: .614 WATTS

AVAILABLE POWER: 100.000 WATTS

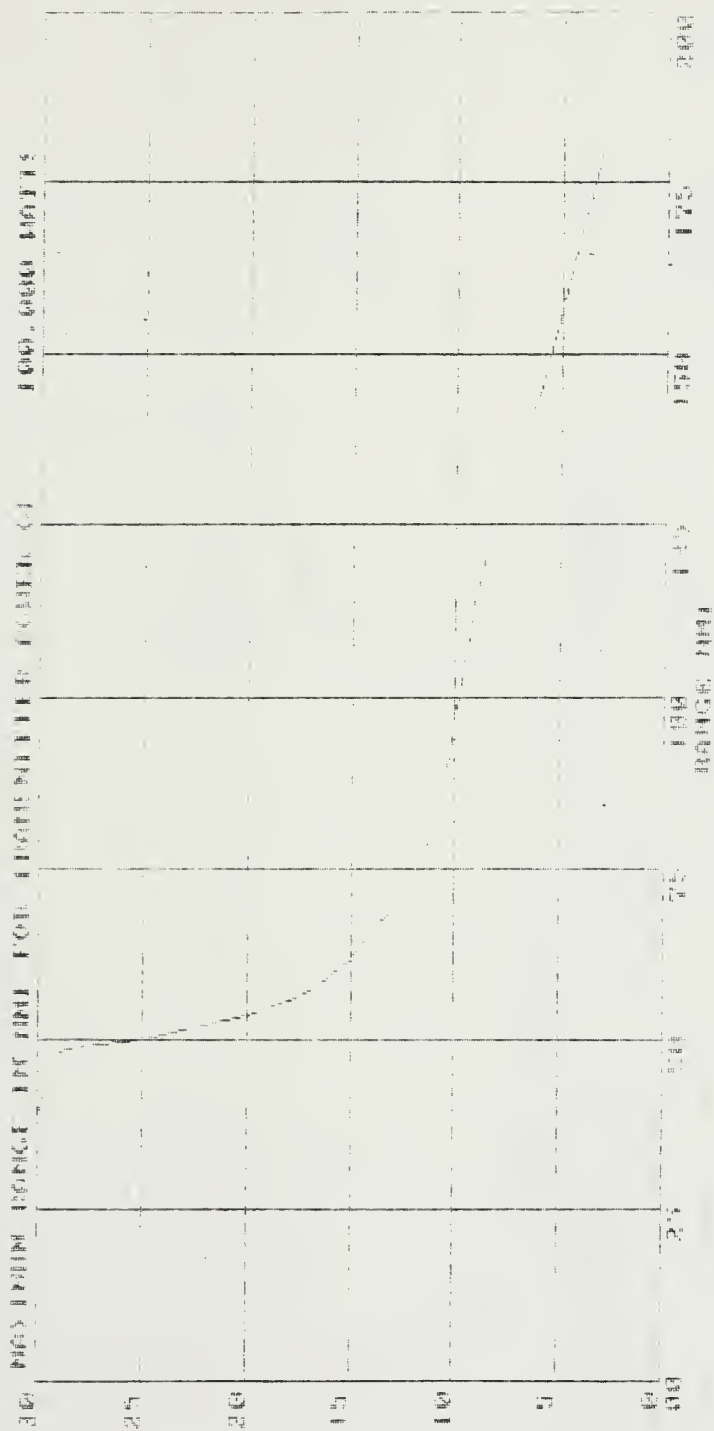
MAX RANGE FOR POWER OF 100.000 WATTS: 148.7 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

*** UNCLASSIFIED ***

GROUNDWATER ANALYSIS FOR DATE: 7/1/80 TIME: 18:00 H
 WELL: HELLO4 POLARIZATION: 0 POWER: 100.000 HATS
 WELL: HELLO4 FREQUENCY: 5.600 MHz RANGE: 47.7 HAT
 WELLS: HELLO4 HEIGHT: 500.0 MET CORR: 0.4 FEET
 ELEVATION: 85 COVER: 77 WIND: 25.0 KNOTS ATMOSPHERIC NOISE: YES
 ELECTRIC: 81.0 SURFACE CONDUCTIVITY: 300000 MUOM
 RES. SURF: 13.0 DB BACKGROUND: 3.000 KHZ NOISE NOISE: 50



*** UNCLASSIFIED ***

1 AREA COVERAGE 1 DATE: 7/1/86 TIME: 18:00 H

TRANSMITTER FREQUENCY: 8.98 MHZ



86.0 66.0 LON: WEST

HEL01 (&) COVERAGE = X

CHROMAWARE

PAGE 1

*** UNCLASSIFIED ***

DATE: 7/1/86 TIME: 18:00 UT ATMOSPHERIC NOISE: YES
FREQ: 9.4 SSN: 50.0 RP: 1.0 MAX MADE NOISE: 51
VMR: HELD 36-0-0 N 76-0-0 HNT: 0.0 KONNIT: PWR:
RCUR: HEOK 36-40-12 N 76-31-41 HNT: 132.0 KONNIT: RANGE: 47.7 NM
IONOSPHERE: FOF2= 3.5 MHz FORT= 4.9 MHz FOF2= 7.5
HMF2= 252. KM VMF2= 119.7 KM

110100Z JUL 86

PROPAGATING MODES MAX MODES ALLOWED 3 EACH TIC= 100 KM

RAYON LAUNCH ANGLES: START= 1.00 END= 87.00 INC= 2.00

*** UNCLASSIFIED *** DATE: 7/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO1 ON: 8.984 MHZ
 RANGE TO RECEIVER NFOLK IS: 106.0 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 104.59 dB
 REQUIRED POWER: 57.389 WATTS
 AVAILABLE POWER: 100.000 WATTS
 MAX RANGE FOR POWER OF 100.000 WATTS: 115.1 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

*** UNCLASSIFIED *** DATE: 7/ 1 AT 18:00 UT
 GROUNDWAVE IS FROM HELO2 ON: 8.984 MHZ
 RANGE TO RECEIVER NFOLK IS: 198.9 NMI
 TRANSMIT GROUNDWAVE GAIN: .0 dBi
 POLARIZATION: V
 TRANSMIT ANTENNA HEIGHT: 500.0 FEET
 RECEIVE ANTENNA HEIGHT: .0 FEET
 TRANSMITTER POWER: 100.0 WATTS
 REQUIRED BANDWIDTH: 2.8 KHZ
 REQUIRED SIGNAL TO NOISE: 12.0 dB
 TERRAIN: SE
 SURFACE COVER: //
 SURFACE CONDUCTIVITY: .40E+01 MHO/M
 DIELECTRIC: 81.00
 WIND VELOCITY: 25.0 KNOTS
 MANMADE NOISE MODEL: SH
 ATMOSPHERIC NOISE: YES
 CALCULATED GROUNDWAVE LOSS: 127.36 dB
 REQUIRED POWER: 10841.040 WATTS
 AVAILABLE POWER: 100.000 WATTS
 ** SURFACE WAVE PROPAGATION TO RECEIVER NFOLK UNLIKELY **
 MAX RANGE FOR POWER OF 100.000 WATTS: 115.2 NMI
 NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi
 GW>

SELECT DISPLAY OPTION (A/F/P/E)

GW>a

*** UNCLASSIFIED *** DATE: 7/ 1 AT 18:00 UT

GROUNDWAVE IS FROM HELO4 ON: 8.984 MHZ

RANGE TO RECEIVER NFOLK IS: 47.7 NMI

TRANSMIT GROUNDWAVE GAIN: .0 dBi

POLARIZATION: V

TRANSMIT ANTENNA HEIGHT: 500.0 FEET

RECEIVE ANTENNA HEIGHT: .0 FEET

TRANSMITTER POWER: 100.0 WATTS

REQUIRED BANDWIDTH: 2.8 KHZ

REQUIRED SIGNAL TO NOISE: 12.0 dB

TERRAIN: SE

SURFACE COVER: //

SURFACE CONDUCTIVITY: .40E+01 MHO/M

DIELECTRIC: 81.00

WIND VELOCITY: 25.0 KNOTS

MANMADE NOISE MODEL: SH

ATMOSPHERIC NOISE: YES

CALCULATED GROUNDWAVE LOSS: 86.77 dB

REQUIRED POWER: .949 WATTS

AVAILABLE POWER: 100.000 WATTS

MAX RANGE FOR POWER OF 100.000 WATTS: 115.1 NMI

NOTE: RECEIVE ANTENNA GROUNDWAVE GAIN ASSUMED = 0.0 dBi

GW>

GW67,1,10.87245,6.174135,1.413314,11.44021,6.174135,1.413314,.0254,
GW68,1,10.87245,7.55909,1.016869,11.44021,7.55909,1.016869,.0254,
GW69,1,11.11553,4.339489,3.55933,11.44021,4.339489,1.016869,.0254,
GW70,1,11.30594,4.339489,1.590991,11.70527,4.339489,1.590991,.0254,
GW71,1,11.30594,7.55909,1.590991,11.70527,7.55909,1.590991,.0254,
GW72,3,11.44021,4.339489,1.016869,11.44021,5.784055,1.016869,.0254,
GW73,1,11.44021,4.339489,1.016869,11.70527,4.339489,1.590991,.0254,
GW74,1,11.44021,5.784055,7.645325,11.44021,5.784055,1.016869,.0254,
GW75,1,11.44021,5.784055,7.645325,11.70527,5.784055,6.331555,.0254,
GW76,1,11.44021,5.784055,1.016869,11.44021,5.784055,1.413314,.0254,
GW77,1,11.44021,6.174135,7.645325,11.44021,6.174135,1.016869,.0254,
GW78,1,11.44021,6.174135,7.645325,11.70527,6.174135,6.331555,.0254,
GW79,1,11.44021,6.174135,1.016869,11.44021,6.174135,1.413314,.0254,
GW80,3,11.44021,6.174135,1.016869,11.44021,7.55909,1.016869,.0254,
GW81,1,10.87245,7.55909,1.016869,11.30594,7.55909,1.590991,.0254,
GW82,1,10.51999,7.55909,5.584964,10.87245,7.55909,1.016869,.0254,
GW83,1,11.44021,7.55909,1.016869,11.70527,7.55909,1.590991,.0254,
GW84,1,11.11553,7.55909,3.55933,11.44021,7.55909,1.016869,.0254,
GW85,1,10.87245,5.653257,1.413314,10.87245,5.927586,1.413314,.0254,
GW86,1,11.44021,5.784055,7.645325,11.44021,6.174135,7.645325,.0254,
GW87,1,10.87245,5.653257,6.707745,10.87245,5.940319,6.707745,.0254,
GW88,2,11.8679,5.933952,2.162221,12.68163,5.933952,2.162221,.0254,
GW89,1,11.8679,5.933952,2.162221,12.21863,5.933952,2.70046,.0254,
GW90,1,12.04558,6.174135,4.618447,12.48543,6.174135,4.618447,.0254,
GW91,1,12.48543,5.784055,4.618447,13.04682,5.784055,5.584964,.0254,
GW92,1,12.48543,6.174135,4.618447,13.04682,6.174135,5.584964,.0254,
GW93,1,13.69271,5.784055,1.144773,13.69271,6.174135,1.144773,.0254,
GW94,2,13.04682,5.784055,5.584964,13.69271,5.784055,1.144773,.0254,
GW95,2,13.04682,6.174135,5.584964,13.69271,6.174135,1.144773,.0254,
GW96,1,13.04682,5.784055,5.584964,13.04682,6.174135,5.584964,.0254,
GW97,2,13.47105,5.933952,2.162221,13.69271,5.784055,1.144773,.0254,
GW98,2,13.47105,5.933952,2.162221,13.69271,6.174135,1.144773,.0254,
GW99,2,13.47105,5.933952,2.162221,13.63773,5.821674,3.249118,.0254,
GW100,2,12.74414,5.933952,3.506663,13.69271,5.784055,3.609681,.0254,
GW101,1,11.70527,6.174135,6.331555,12.04558,6.174135,4.618447,.0254,
GW102,2,11.44021,5.784055,1.413314,11.8679,5.933952,2.162221,.0254,
GW103,2,11.44021,6.174135,1.413314,11.8679,5.933952,2.162221,.0254,
GW104,2,7.009854,5.147427,7.813162E-02,7.787118,5.250445,1.869372,.0254,
GW105,2,7.009854,6.77951,7.813162E-02,7.790012,6.657393,1.840434,.0254,
GW106,1,5.425229,5.1509,1.743782,6.102369,5.241185,1.716002,.0254,
GW107,1,7.009854,5.553133,2.685992,7.009854,5.958839,2.685992,.0254,
GW108,1,7.583976,5.653257,2.140228,7.583976,6.174135,2.140228,.0254,
GW109,1,5.425229,6.841436,1.743782,6.030377,6.732631,1.718896,.0254,
GW110,1,5.126013,5.784055,1.759408,5.126013,5.53114,1.759408,.0254,
GW111,3,3.728325,6.876162,1.590991,5.126013,7.072359,1.759408,.0254,
GW112,1,7.583976,6.174135,2.140228,7.796379,6.145776,2.074829,.0254,
GW113,1,7.583976,5.653257,2.140228,7.802745,5.687404,2.071356,.0254,
GW114,2,2.826628,6.670126,0.,3.731219,6.795137,1.562632E-02,.0254,
GW115,3,3.728325,5.275332,1.590991,5.126013,4.901457,1.759408,.0254,
GW116,1,7.583976,6.174135,2.140228,7.384307,6.383064,2.140228,.0254,
GW117,1,7.583976,5.653257,2.140228,7.394146,5.48484,2.140228,.0254,
GW118,1,7.394146,5.48484,2.140228,7.412665,5.415968,1.666229,.0254,
GW119,1,7.394146,5.48484,2.140228,7.000594,5.443749,2.140228,.0254,
GW120,1,7.384307,6.383064,2.140228,7.000594,6.439203,2.140228,.0254,
GW121,1,5.126013,5.275332,2.140228,5.4941,5.310057,2.140228,.0254,
GW122,1,5.126013,6.670126,2.140228,5.496994,6.623247,2.140228,.0254,
GW123,2,7.000594,5.443749,2.140228,6.083849,5.362723,2.140228,.0254,
GW124,2,7.000594,6.439203,2.140228,6.077483,6.551481,2.140228,.0254,
GW125,1,7.384307,6.383064,2.140228,7.384307,6.520229,1.669123,.0254,
GW126,2,5.126013,7.072359,1.759408,5.135274,7.028953,8.675504,.0254,
GW127,2,5.126013,4.901457,1.759408,5.1509,4.926343,8.733379,.0254,
GW128,1,3.728325,5.275332,1.590991,3.724853,5.209932,8.831767,.0254,
GW129,3,3.718487,5.128907,1.562632E-02,5.172314,4.947758,.0405127,.0254,
GW130,2,7.009854,5.147427,7.813162E-02,6.093109,5.047882,.05903278,.0254,
GW131,3,3.731219,6.795137,1.562632E-02,5.144534,6.98844,.0405127,.0254,
GW132,1,3.728325,6.876162,1.590991,3.728325,6.838543,8.831767,.0254,
GW133,2,3.718487,5.128907,1.562632E-02,3.724853,5.933952,.01562632,.0254,
GW134,2,5.144534,6.98844,.0405127,5.16016,5.952472,.0405127,.0254,
GW135,2,7.009854,6.77951,7.813162E-02,6.098897,6.881949,.05903278,.0254,
GW136,2,7.009854,5.147427,7.813162E-02,7.009854,5.927586,.07813162,.02554,
GW137,2,7.009854,6.77951,7.813162E-02,7.009854,6.77951,.8704442,.0254,
GW138,2,7.009854,5.147427,7.813162E-02,7.00696,5.147427,.8640779,.0254,

GW139,1,9.349752,5.453588,.4022332,9.349752,5.453588,.8675504,.0254,
 GW140,1,9.349752,5.453588,.4022332,9.349752,5.936846,.4022332,.0254,
 GW141,1,9.349752,6.411423,.4022332,9.353224,6.411423,.8704442,.0254,
 GW142,2,10.87245,6.553257,1.413314,10.0894,5.550239,1.47582,.0254,
 GW143,2,10.87245,6.174135,1.413314,10.0865,6.295673,1.47582,.0254,
 GW144,1,9.349752,5.933952,1.590991,9.349752,5.453588,1.534852,.0254,
 GW145,1,9.349752,5.933952,1.590991,9.356117,6.411423,1.534852,.0254,
 GW146,1,10.0865,6.295673,.5336101,10.0894,5.940319,.5336101,.0254,
 GW147,2,10.0865,6.295673,.5336101,10.87245,6.174135,.6707745,.0254,
 GW148,1,10.0865,6.295673,1.47582,9.356117,6.411423,1.534852,.0254,
 GW149,1,10.0865,6.295673,.5336101,10.0865,6.295673,.8640779,.0254,
 GW150,1,10.0894,5.550239,1.47582,9.349752,5.453588,1.534852,.0254,
 GW151,1,10.09229,5.550239,.5336101,10.09229,5.550239,.8704442,.0254,
 GW152,1,10.0865,6.295673,1.47582,10.0865,5.946106,1.47582,.0254,
 GW153,2,9.349752,5.453588,.4022332,8.585797,5.353463,.2963214,.0254,
 GW154,2,9.349752,5.453588,1.534852,8.573065,5.353463,1.588098,.0254,
 GW155,1,7.787118,5.250445,.1869372,7.787118,5.250445,.8768104,.0254,
 GW156,2,7.787118,5.250445,.1869372,8.585797,5.353463,.2963214,.0254,
 GW157,2,8.573065,5.353463,1.588098,7.790012,5.250445,1.644237,.0254,
 GW158,1,8.585797,5.353463,.2963214,8.579432,5.353463,.8704442,.0254,
 GW159,2,9.356117,6.411423,1.534852,8.576537,6.532961,1.590991,.0254,
 GW160,2,9.349752,6.411423,.4022332,8.570171,6.532961,.2934277,.0254,
 GW161,1,8.585797,5.353463,.2963214,8.576537,5.955945,.2934277,.0254,
 GW162,1,7.790012,6.657393,.1840434,8.10659,6.607042,.2286073,.0254,
 GW163,1,7.787118,5.250445,.1869372,7.787118,5.940319,.1869372,.0254,
 GW164,1,8.576537,6.532961,1.590991,8.573065,6.532961,.8640779,.0254,
 GW165,1,8.576537,6.532961,1.590991,8.112378,6.605884,1.622244,.0254,
 GW166,1,7.790012,6.657393,.1840434,7.790012,6.657393,.8733379,.0254,
 GW167,2,9.349752,5.933952,1.590991,8.548179,5.709396,1.622244,.0254,
 GW168,1,8.573065,5.353463,1.588098,8.548179,5.709396,1.622244,.0254,
 GW169,2,9.349752,5.933952,1.590991,8.573065,5.808942,1.834646,.0254,
 GW170,1,8.548179,5.709396,1.622244,8.573065,5.808942,1.834646,.0254,
 GW171,2,9.349752,5.933952,1.590991,8.566699,6.039864,1.834646,.0254,
 GW172,1,8.573065,5.808942,1.834646,8.566699,6.039864,1.834646,.0254,
 GW173,2,9.349752,5.933952,1.590991,8.566699,6.180501,1.622244,.0254,
 GW174,1,8.576537,6.532961,1.590991,8.566699,6.180501,1.622244,.0254,
 GW175,1,8.566699,6.039864,1.834646,8.566699,6.180501,1.622244,.0254,
 GW176,2,7.790012,5.250445,1.644237,7.000594,5.147427,1.684749,.0254,
 GW177,2,7.787118,6.657393,1.644237,7.009854,6.77951,1.681277,.0254,
 GW178,2,8.548179,5.709396,1.622244,7.796379,5.496994,1.650603,.0254,
 GW179,1,7.790012,5.250445,1.644237,7.796379,5.496994,1.650603,.0254,
 GW180,2,7.802745,5.687404,2.071356,8.573065,5.808942,1.834646,.0254,
 GW181,1,7.802745,5.687404,2.071356,7.796379,5.496994,1.650603,.0254,
 GW182,2,7.796379,6.145776,2.074829,8.566699,6.039864,1.834646,.0254,
 GW183,1,7.796379,6.145776,2.074829,7.802745,5.687404,2.071356,.0254,
 GW184,2,8.566699,6.180501,1.622244,7.787118,6.426471,1.653497,.0254,
 GW185,1,7.796379,6.145776,2.074829,7.787118,6.426471,1.653497,.0254,
 GW186,1,7.787118,6.657393,1.644237,7.787118,6.426471,1.653497,.0254,
 GW187,1,7.412665,5.415968,1.666229,7.796379,5.496994,1.650603,.0254,
 GW188,1,7.384307,6.520229,1.669123,7.787118,6.426471,1.653497,.0254,
 GW189,1,7.384307,6.520229,1.669123,7.01622,6.57984,1.684749,.0254,
 GW190,1,7.009854,6.77951,1.681277,7.01622,6.57984,1.684749,.0254,
 GW191,1,7.000594,6.439203,2.140228,7.01622,6.57984,1.684749,.0254,
 GW192,1,7.412665,5.415968,1.666229,7.009854,5.362723,1.681277,.0254,
 GW193,1,7.000594,5.443749,2.140228,7.009854,5.362723,1.681277,.0254,
 GW194,1,7.000594,5.147427,1.684749,7.009854,5.362723,1.681277,.0254,
 GW195,2,5.144534,6.98844,.0405127,6.098897,6.881949,5.903278E-02,.0254,
 GW196,2,6.080377,6.923041,1.718896,7.009854,6.77951,1.681277,.0254,
 GW197,2,6.098897,6.881949,5.903278E-02,6.089637,6.901048,.8733379,.0254,
 GW198,2,6.080377,6.732631,1.718896,7.01622,6.57984,1.684749,.0254,
 GW199,1,6.080377,6.923041,1.718896,6.080377,6.732631,1.718896,.0254,
 GW200,1,5.496994,6.623247,2.140228,6.077483,6.551481,2.140228,.0254,
 GW201,1,6.080377,6.732631,1.718896,6.077483,6.551481,2.140228,.0254,
 GW202,2,6.102369,6.539328,2.685992,7.009854,6.364544,2.685992,.0254,
 GW203,2,5.172314,4.947758,.0405127,6.093109,5.047882,5.903278E-02,.0254,
 GW204,2,6.098897,6.881949,5.903278E-02,6.096003,5.965205,.05903278,.0254,
 GW205,2,6.089637,5.029362,1.722368,7.000594,5.147427,1.684749,.0254,
 GW206,2,6.093109,5.047882,5.903278E-02,6.093109,5.038622,.8768104,.0254,
 GW207,2,6.102369,5.241185,1.716002,7.009854,5.362723,1.681277,.0254,
 GW208,1,6.089637,5.029362,1.722368,6.102369,5.241185,1.716002,.0254,
 GW209,1,5.4941,5.310057,2.140228,6.083849,5.362723,2.140228,.0254,
 GW210,1,6.102369,5.241185,1.716002,6.083849,5.362723,2.140228,.0254,

GW211,2,6.093109,5.393976,2.685992,7.009854,5.553133,2.685992,.0254,
 GW212,1,6.102369,6.539328,2.685992,6.096003,5.965205,2.685992,.0254,
 GW213,1,12.04558,6.174135,.4618447,12.04558,5.784055,.4618447,.0254,
 GW214,1,11.70527,5.784055,.6331555,12.04558,5.784055,.4618447,.0254,
 GW215,1,12.48543,5.784055,.4618447,12.04558,5.784055,.4618447,.0254,
 GW216,1,7.009854,5.553133,2.685992,7.394146,5.48484,2.140228,.0254,
 GW217,1,7.009854,5.553133,2.685992,7.000594,5.443749,2.140228,.0254,
 GW218,1,6.093109,5.393976,2.685992,6.083849,5.362723,2.140228,.0254,
 GW219,1,7.009854,6.364544,2.685992,7.384307,6.383064,2.140228,.0254,
 GW220,1,7.009354,6.364544,2.685992,7.000594,6.439203,2.140228,.0254,
 GW221,1,6.102369,6.539328,2.685992,6.077483,6.551481,2.140228,.0254,
 GW222,2,3.728325,6.876162,1.590991,3.728325,6.080377,1.590991,.0254,
 GW223,2,4.782813,6.077483,1.759408,3.728325,6.080377,1.590991,.0254,
 GW224,1,3.728325,5.784055,1.590991,3.728325,6.080377,1.590991,.0254,
 GW225,2,3.728325,5.784055,1.590991,4.782813,5.784055,1.759408,.0254,
 GW226,2,3.731219,6.795137,1.562632E-02,3.728325,6.838543,.8831767,.0254,
 GW227,2,2.826628,6.670126,.8704442,3.728325,6.838543,.8831767,.0254,
 GW228,2,5.135274,7.028953,.8675504,5.144534,6.98844,.0405127,.0254,
 GW229,3,5.135274,7.028953,.8675504,3.728325,6.838543,.8831767,.0254,
 GW230,2,6.080377,6.923041,1.718896,6.089637,6.901048,.8733379,.0254,
 GW231,2,5.135274,7.028953,.8675504,6.089637,6.901048,.8733379,.0254,
 GW232,2,7.009854,6.77951,.8704442,7.009854,6.77951,1.681277,.0254,
 GW233,2,7.009854,6.77951,.8704442,6.089637,6.901048,.8733379,.0254,
 GW234,2,7.787118,6.657393,1.644237,7.790012,6.657393,.8733379,.0254,
 GW235,2,7.009854,6.77951,.8704442,7.790012,6.657393,.8733379,.0254,
 GW236,1,8.570171,6.532961,.2934277,8.573065,6.532961,.8640779,.0254,
 GW237,1,8.573065,6.532961,.8640779,8.110642,6.606463,.8692867,.0254,
 GW238,1,9.353224,6.411423,.8704442,9.356117,6.411423,1.534852,.0254,
 GW239,2,9.353224,6.411423,.8704442,8.573065,6.532961,.8640779,.0254,
 GW240,1,10.0365,6.295673,1.47582,10.0865,6.295673,.8640779,.0254,
 GW241,1,9.353224,6.411423,.8704442,10.0865,6.295673,.8640779,.0254,
 GW242,2,10.87245,6.174135,1.016869,10.0865,6.295673,.8640779,.0254,
 GW243,1,10.0894,5.550239,1.47582,10.0865,5.946106,1.47582,.0254,
 GW244,1,9.349752,5.933952,1.590991,10.0865,5.946106,1.47582,.0254,
 GW245,2,10.09229,5.550239,.5336101,10.87245,5.653257,.6707745,.0254,
 GW246,1,10.87245,6.174135,1.413314,10.87245,5.927586,1.413314,.0254,
 GW247,2,10.87245,5.927586,1.413314,10.0865,5.946106,1.47582,.0254,
 GW248,1,2.826628,6.670126,0,.2.826628,5.936846,0,.0254,
 GW249,2,3.731219,6.795137,1.562632E-02,3.724853,5.933952,.01562632,.0254,
 GW250,2,2.826628,5.936846,0,3.724853,5.933952,1.562632E-02,.0254,
 GW251,2,5.172314,4.947758,.0405127,5.16016,5.952472,.0405127,.0254,
 GW252,3,3.724853,5.933952,1.562632E-02,5.16016,5.952472,.0405127,.0254,
 GW253,2,6.093109,5.047882,5.903278E-02,6.096003,5.965205,.05903278,.0254,
 GW254,2,5.16016,5.952472,.0405127,6.096003,5.965205,5.903278E-02,.0254,
 GW255,2,3.718487,5.128907,1.562632E-02,3.724853,5.209932,.8831767,.0254,
 GW256,2,2.826628,5.275332,.8704442,3.724853,5.209932,.8831767,.0254,
 GW257,2,5.1509,4.926343,.8733379,5.172314,4.947758,.0405127,.0254,
 GW258,3,5.1509,4.926343,.8733379,3.724853,5.209932,.8831767,.0254,
 GW259,2,7.009854,6.77951,7.813162E-02,7.009854,5.927586,.07813162,.0254,
 GW260,2,7.009854,5.927586,7.813162E-02,6.096003,5.965205,.05903278,.0254,
 GW261,1,7.790012,6.657393,1.840434,7.787118,5.940319,.1869372,.0254,
 GW262,2,7.009854,5.927586,7.813162E-02,7.787118,5.940319,.1869372,.0254,
 GW263,1,8.570171,6.532961,.2934277,8.576537,5.955945,.2934277,.0254,
 GW264,2,8.576537,5.955945,.2934277,7.787118,5.940319,.1869372,.0254,
 GW265,2,6.089637,5.029362,1.722368,6.093109,5.038622,.8768104,.0254,
 GW266,2,5.1509,4.926343,.8733379,6.093109,5.038622,.8768104,.0254,
 GW267,2,7.00696,5.147427,.8640779,7.000594,5.147427,1.684749,.0254,
 GW268,2,7.00696,5.147427,.8640779,6.093109,5.038622,.8768104,.0254,
 GW269,2,7.787118,5.250445,.8768104,7.790012,5.250445,1.644237,.0254,
 GW270,2,7.00696,5.147427,.8640779,7.787118,5.250445,.8768104,.0254,
 GW271,1,8.573065,5.353463,1.588098,8.579432,5.353463,.8704442,.0254,
 GW272,2,7.787118,5.250445,.8768104,8.579432,5.353463,.8704442,.0254,
 GW273,1,9.349752,6.411423,.4022332,9.349752,5.936846,.4022332,.0254,
 GW274,2,9.349752,5.936846,.4022332,8.576537,5.955945,.2934277,.0254,
 GW275,1,10.09229,5.550239,.5336101,10.0894,5.940319,.5336101,.0254,
 GW276,2,9.349752,5.936846,.4022332,10.0894,5.940319,.5336101,.0254,
 GW277,1,9.349752,5.453588,.8675504,9.349752,5.453588,1.534852,.0254,
 GW278,2,9.349752,5.453588,.8675504,8.579432,5.353463,.8704442,.0254,
 GW279,1,10.0894,5.550239,1.47582,10.09229,5.550239,.8704442,.0254,
 GW280,1,9.349752,5.453588,.8675504,10.09229,5.550239,.8704442,.0254,
 GW281,2,10.87245,5.653257,1.016869,10.09229,5.550239,.8704442,.0254,
 GW282,1,11.44021,5.784055,1.413314,11.44021,6.174135,1.413314,.0254,


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GW283,1,10.87245,6.174135,.6707745,10.87245,5.940319,.6707745,.0254,
GW284,2,10.87245,5.940319,.6707745,10.0894,5.940319,.5336101,.0254,
GW285,1,6.093109,5.393976,2.685992,6.096003,5.965205,2.685992,.0254,
GW286,1,7.009854,6.364544,2.685992,7.009854,5.958839,2.685992,.0254,
GW287,2,7.009854,5.958839,2.685992,6.096003,5.965205,2.685992,.0254,
GW288,1,5.425229,6.670126,2.685992,5.425229,5.977359,2.685992,.0254,
GW289,1,6.096003,5.965205,2.685992,5.968099,5.968099,2.685992,.0254,
GW290,1,5.425229,5.977359,2.685992,5.968099,5.968099,2.685992,.0254,
GW291,1,5.968099,5.968099,2.685992,5.968099,5.968099,2.885661,.0254,
GW292,12,5.968099,5.968099,2.885661,5.968099,11.9362,2.885661,.0254,
GW293,12,5.968099,5.968099,2.885661,5.968099,0.,2.885661,.0254,
GW294,12,5.968099,5.968099,2.885661,0.,5.968099,2.885661,.0254,
GW295,12,5.968099,5.968099,2.885661,11.9362,5.968099,2.885661,.0254,
GW296,1,7.790012,6.657393,.8733379,8.110642,6.606463,.8692867,.0254,
GW297,1,7.787118,6.657393,1.644237,8.112378,6.605884,1.622244,.0254,
GW298,2,8.110642,6.606463,.8692867,8.112378,6.605884,1.622244,.0254,
GW299,1,8.570171,6.532961,.2934277,8.10659,6.607042,.2286073,.0254,
GW300,1,8.110642,6.606463,.8692867,8.10659,6.607042,.2286073,.0254,
GW310,1,12.55083,5.933952,3.209763,12.74414,5.933952,3.506663,.0254,
GW320,2,13.47105,5.933952,2.162221,12.68163,5.933952,2.162221,.0254,
GW321,2,12.48543,6.174135,.4618447,12.58209,6.056069,1.298142,.0254,
GW322,2,12.68163,5.933952,2.162221,12.58209,6.056069,1.298142,.0254,
GW324,1,12.48543,6.174135,.4618447,12.48543,5.784055,.4618447,.0254,
GW326,1,12.21863,5.933952,2.70046,12.55083,5.933952,3.209763,.0254,
GW327,1,13.69271,5.784055,3.609681,13.63773,5.821674,3.249118,.0254,
*****GM 0,0,0,180 (MOVE UP @ GND) (ROTATE ABOUT Z AXIS)
*****GE (GEI FOR GROUND *** AND ADD GN AND GM CARDS)
*****FR 0,0,0,18.1,0

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WG

*****SPACE=12" LONGWIRE ANTENNA*****

NX

CM HH-65A DATA

CM CREATED 8/16/87

CM SPACE=12" LONGWIRE ANTENNA

CE

GF

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GW401,2,8.110642,6.606463,.8692867,8.18125,6.895364,1.617614,.0254,
GW402,5,11.94025,5.484158,1.413314,12.74414,5.634055,3.206869,.0254,
GW403,1,12.74414,6.233849,3.206869,12.74414,5.634055,3.206869,.0254,
GW404,8,8.187615,5.002636,1.615299,11.94025,5.484158,1.413314,.0254,
GW405,8,11.94025,6.474032,1.413314,8.18125,6.895364,1.617614,.0254,
GW406,5,11.94025,6.474032,1.413314,12.74414,6.233849,3.206869,.0254,
GM 0,0,0,180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)

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GE

EX 0,402,3,01,1,0 (1 VOLT EXCITATION, ANT = TAG 402)

PL3, 2, 0,4

RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT

PL3, 2, 0,4

RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG

PL3, 1, 0,4

RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT

PL3, 1, 0,4

RP0, 361, 1, 1000, 0,45, 1, 0 VERT CUT AT PHI = 45 DEG

XQ

*****COLLINS 437R-2 ANTENNA*****

NX

CM H65 IGUANA DATA

CM COLLINS 437R-2 ANTENNA

CM STANDARD RADIATION PATTERNS

CE

GF

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GW401,3,8.110642,6.606463,.8692867,8.110642,7.063678,.8692867,.0254 ANT
GW402,15,8.110642,7.063678,.8692867,11.99986,5.99993,.1996697,.0254 ANT
GM 0,0,0,180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)

```

GE

EX 0,401,2,01,1,0 (1 VOLT EXCITATION, ANT = TAG 401)

PL3, 2, 0,4

RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT

PL3, 2, 0,4

RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG

PL3, 1, 0,4

RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT


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PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 45, 1, 0 VERT CUT AT PHI = 45 DEG
XQ
*****STANDARD TUBE INSTALLATION*****
NX
CM H65 IGUANA DATA CREATED 7/29/87
CM STANDARD TUBE ANTENNA
CE
GF
GW401, 1, 8.110642, 6.606463, .8692867, 8.110642, 6.860536, .8692867, .0254 ANT
GW402, 1, 11.44021, 6.174135, 1.413314, 11.44021, 6.428207, 1.413314, .0254 ANT
GW403, 14, 11.44021, 6.428207, 1.413314, 8.110642, 6.860536, .8692867, .0254 ANT
GM 0, 0, 0, 0, 180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)
GE
EX 0, 403, 13, 01, 1, 0 (1 VOLT EXCITATION, ANT = TAG 403)
PL3, 2, 0, 4
RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT
PL3, 2, 0, 4
RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 45, 1, 0 VERT CUT AT PHI = 45 DEG
XQ
*****TRIVEC LONG TUBE INSTALLATION*****
NX
CM CREATED 7/30/87
CM LONG TRIVEC TUBE ANTENNA MODEL
CM EXCITATION ON SHORT STUB
CE
GF
GW401, 3, 8.110642, 6.860536, .8692867, 8.110642, 7.160329, .8692867, .0254 ANT
GW402, 14, 8.110642, 7.160329, .8692867, 11.44021, 6.728001, 1.413314, .0254 ANT
GW403, 2, 8.110642, 6.606463, .8692867, 8.110642, 6.860536, .8692867, .0254 ANT
GW404, 6, 11.44021, 6.423207, 1.413314, 10.08419, 6.604148, 1.191652, .0254 ANT
GW405, 2, 12.44434, 5.933952, 2.706827, 12.44434, 6.188025, 2.706827, .0254 ANT
GW406, 4, 11.44021, 6.428207, 1.413314, 11.91073, 6.315351, 2.019847, .0254 ANT
GW407, 4, 12.44434, 6.188025, 2.706827, 11.91073, 6.315351, 2.019847, .0254 ANT
GW408, 2, 11.91073, 6.315351, 2.019847, 11.91073, 6.061278, 2.019847, .0254 ANT
GW409, 1, 11.8679, 5.933952, 2.162221, 11.91073, 6.061278, 2.019847, .0254 ANT
GW410, 2, 12.74414, 5.933952, 3.506663, 12.55083, 5.933952, 3.209763, .0254 ANT
GW411, 2, 12.44434, 5.933952, 2.706827, 12.21863, 5.933952, 2.70046, .0254 ANT
GW412, 6, 8.110642, 6.860536, .8692867, 9.348015, 6.699642, 1.071271, .0254 ANT
GW413, 2, 9.353224, 6.411423, .8704442, 9.348015, 6.699642, 1.071271, .0254 ANT
GW414, 4, 9.348015, 6.699642, 1.071271, 10.08419, 6.604148, 1.191652, .0254 ANT
GW415, 2, 10.0865, 6.295673, .8640779, 10.08419, 6.604148, 1.191652, .0254 ANT
GW416, 2, 12.44434, 6.188025, 2.706827, 12.44434, 6.487819, 2.706827, .0254 ANT
GW417, 6, 11.44021, 6.728001, 1.413314, 12.44434, 6.487819, 2.706827, .0254 ANT
GW418, 1, 11.44021, 6.174135, 1.413314, 11.44021, 6.428207, 1.413314, .0254,
GM 0, 0, 0, 0, 180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)
GE
EX 0, 401, 2, 01, 1, 0 (1 VOLT EXCITATION, ANT = TAG 401)
PL3, 2, 0, 4
RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT
PL3, 2, 0, 4
RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 45, 1, 0 VERT CUT AT PHI = 45 DEG
XQ
EN

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CM H60 IGUANA DATA CREATED 7/31/87
CM GREEN'S FUNCTION FOR HELICOPTER
CM FINAL GW CARDS

*****CM FREE SPACE
*****CM FREQ = 26.836MHZ

CE
GW1,3,4.26702,9.397726,.150275,5.867054,9.397726,.150275,.0254,
GW2,3,5.867054,9.397726,.150275,7.187892,9.397726,.150275,.0254,
GW3,2,7.187892,9.397726,.150275,8.382183,9.397726,.150275,.0254,
GW4,1,8.978538,9.397726,.150275,9.575684,9.397726,.150275,.0254,
GW5,2,4.26702,9.397726,.150275,4.26702,8.229535,.150275,.0254,
GW6,2,5.867054,9.397726,.150275,5.867054,8.229535,.150275,.0254,
GW7,2,7.187892,9.397726,.150275,7.187892,8.229535,.150275,.0254,
GW8,2,8.382183,9.397726,.150275,8.382183,8.229535,.150275,.0254,
GW9,2,9.575684,9.397726,.150275,9.575684,8.229535,.150275,.0254,
GW10,2,10.73122,8.229535,.150275,10.73122,9.042603,.150275,.0254,
GW11,2,11.88755,8.686688,.150275,11.88755,8.229535,.150275,.0254,
GW12,1,12.53452,8.229535,.2135487,12.53452,8.648724,.2135487,.0254,
GW13,1,13.18228,8.61076,.2776133,13.18228,8.229535,.2776133,.0254,
GW14,1,13.94473,8.229535,.3155776,13.94473,8.58545,.3155776,.0254,
GW15,1,14.70639,8.560141,.3535418,14.70639,8.229535,.3535418,.0254,
GW16,1,5.409901,9.397726,1.978885,5.867054,9.397726,1.978885,.0254,
GW17,1,5.867054,9.397726,1.978885,6.298897,9.397726,1.978885,.0254,
GW18,2,6.298897,9.397726,1.978885,7.187892,9.397726,1.978885,.0254,
GW19,2,7.187892,9.397726,1.978885,8.229535,9.397726,1.978885,.0254,
GW20,1,8.229535,9.397726,1.978885,8.978538,9.397726,1.978885,.0254,
GW21,4,5.409901,9.093222,1.978885,7.187892,9.093222,2.385418,.0254,
GW22,2,7.187892,9.093222,2.385418,8.229535,9.093222,2.385418,.0254,
GW23,1,8.229535,9.397726,2.385418,8.978538,9.397726,2.385418,.0254,
GW24,1,8.978538,9.397726,2.385418,9.575684,9.397726,2.385418,.0254,
GW25,2,5.409901,9.093222,1.978885,5.409901,8.229535,1.978885,.0254,
GW26,1,5.409901,9.397726,1.978885,5.409901,9.093222,1.978885,.0254,
GW27,2,6.298897,8.229535,2.182152,6.298897,9.093222,2.182152,.0254,
GW28,1,6.298897,9.397726,1.978885,6.298897,9.093222,2.182152,.0254,
GW29,2,7.187892,9.093222,2.385418,7.187892,8.229535,2.385418,.0254,
GW30,1,7.187892,9.397726,1.978885,7.187892,9.093222,2.385418,.0254,
GW31,2,8.229535,9.093222,2.385418,8.229535,8.229535,2.385418,.0254,
GW32,1,8.229535,9.093222,2.385418,8.229535,9.397726,2.385418,.0254,
GW33,2,9.575684,9.397726,2.385418,9.575684,8.229535,2.385418,.0254,
GW34,1,10.73122,8.229535,2.182152,10.73122,8.814026,2.182152,.0254,
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GW36,1,8.978538,9.397726,1.978885,8.978538,9.397726,2.385418,.0254,
GW37,1,13.94473,8.58545,.3155776,13.94473,8.408283,.9665057,.0254,
GW38,2,4.648244,9.397726,.7600753,5.867054,9.397726,.7600753,.0254,
GW39,3,5.867054,9.397726,1.06458,7.187892,9.397726,1.06458,.0254,
GW40,1,8.978538,9.397726,1.06458,9.575684,9.397726,1.267847,.0254,
GW41,3,14.70639,8.394837,.9380326,16.05254,8.229535,.9119322,.0254,
GW42,2,4.838856,8.229535,1.06458,4.838856,9.397726,1.06458,.0254,
GW43,16,8.229535,8.229535,3.071147,8.229535,16.45907,3.071147,.0254,
GW44,4,16.50574,8.229535,1.267847,16.67736,10.42197,1.267847,.0254,
GW45,2,16.67736,10.42197,1.267847,17.45247,10.42197,1.267847,.0254,
GW46,4,17.45247,10.42197,1.267847,17.62331,8.229535,1.267847,.0254,
GW47,2,16.67736,10.42197,1.267847,17.06808,9.517155,1.267847,.0254,
GW48,3,4.26702,7.061345,.150275,5.867054,7.061345,.150275,.0254,
GW49,3,5.867054,7.061345,.150275,7.187892,7.061345,.150275,.0254,
GW50,2,7.187892,7.061345,.150275,8.382183,7.061345,.150275,.0254,
GW51,1,8.382183,7.061345,.150275,8.978538,7.061345,.150275,.0254,
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GW53,2,4.26702,8.229535,.150275,4.26702,7.061345,.150275,.0254,
GW54,2,5.867054,8.229535,.150275,5.867054,7.061345,.150275,.0254,
GW55,2,7.187892,8.229535,.150275,7.187892,7.061345,.150275,.0254,
GW56,2,8.382183,8.229535,.150275,8.382183,7.061345,.150275,.0254,
GW57,2,9.575684,8.229535,.150275,9.575684,7.061345,.150275,.0254,
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GW61,1,13.18228,8.229535,.2776133,13.18228,7.848311,.2776133,.0254,
GW62,1,13.94473,8.229535,.3155776,13.94473,7.873621,.3155776,.0254,
GW63,1,14.70639,8.229535,.3535418,14.70639,7.899721,.3535418,.0254,
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GW67,2,7.187892,7.061345,1.978885,8.229535,7.061345,1.978885,.0254,
 GW68,1,8.229535,7.061345,1.978885,8.978538,7.061345,1.978885,.0254,
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 GW72,1,8.978538,7.061345,2.385418,9.575684,7.061345,2.385418,.0254,
 GW73,2,5.409901,8.229535,1.978885,5.409901,7.36585,1.978885,.0254,
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 GW85,2,4.648244,7.061345,.7600753,5.867054,7.061345,.7600753,.0254,
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 GW89,2,4.838856,8.229535,1.06458,4.838856,7.061345,1.06458,.0254,
 GW90,16,8.229535,8.229535,3.071147,8.229535,0.,3.071147,.0254,
 GW91,4,16.50574,8.229535,1.267847,16.67736,6.037892,1.267847,.0254,
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 GW98,3,8.229535,8.229535,2.385418,9.575684,8.229535,2.385418,.0254,
 GW99,1,16.05254,8.229535,.9119322,16.05254,8.229535,1.217228,.0254,
 GW100,1,16.05254,8.229535,.9119322,16.05254,8.229535,.632737,.0254,
 GW101,3,16.05254,8.229535,.9119322,17.39869,8.229535,.9119322,.0254,
 GW102,2,16.05254,8.229535,1.217228,16.73747,8.229535,1.941712,.0254,
 GW103,4,16.73747,8.229535,1.941712,18.26237,8.229535,3.553609,.0254,
 GW104,1,17.39869,8.229535,.9119322,17.60195,8.229535,1.267847,.0254,
 GW105,2,17.60195,8.229535,1.267847,18.05436,8.229535,1.949621,.0254,
 GW106,3,18.05436,8.229535,1.949621,18.92279,8.229535,3.325033,.0254,
 GW107,1,18.26237,8.229535,3.553609,18.92279,8.229535,3.325033,.0254,
 GW108,3,16.73747,8.229535,1.941712,18.05436,8.229535,1.949621,.0254,
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 GW111,2,16.50574,8.229535,1.267847,17.62331,8.229535,1.267847,.0254,
 GW112,1,8.229535,8.229535,2.385418,8.229535,8.229535,3.071147,.0254,
 GW113,16,8.229535,8.229535,3.071147,0.,8.229535,3.071147,.0254,
 GW114,16,8.229535,8.229535,3.071147,16.45907,8.229535,3.071147,.0254,
 GW115,2,11.88755,8.686688,.150275,11.68032,8.750752,.150275,.0254,
 GW117,2,18.92279,8.229535,3.325033,18.1469,8.229535,2.833871,.0254,
 GW118,1,18.26237,8.229535,3.553609,18.1469,8.229535,2.833871,.0254,
 GW119,2,18.05436,8.229535,1.949621,18.1469,8.229535,2.833871,.0254,
 GW120,2,13.94473,8.229535,1.623761,14.70639,8.229535,1.521732,.0254,
 GW121,2,13.18228,8.229535,1.724999,13.94473,8.229535,1.623761,.0254,
 GW122,1,12.53452,8.229535,1.852337,13.18228,8.229535,1.724999,.0254,
 GW123,1,11.88755,8.229535,1.978885,12.53452,8.229535,1.852337,.0254,
 GW124,3,11.88755,8.686688,.150275,12.53452,8.648724,.2135487,.0254,
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 GW127,2,14.70639,8.560141,.3535418,13.94473,8.58545,.3155776,.0254,
 GW128,2,14.70639,7.899721,.3535418,13.94473,7.873621,.3155776,.0254,
 GW129,2,13.18228,7.848311,.2776133,13.94473,7.873621,.3155776,.0254,
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 GW131,1,11.88755,7.772383,.150275,12.53452,7.810347,.2135487,.0254,
 GW132,1,14.70639,8.064233,.9380326,13.95818,8.051578,.9688785,.0254,
 GW133,2,13.18228,8.038923,1.001306,13.95818,8.051578,.9688785,.0254,
 GW134,1,13.18228,8.038923,1.001306,12.54559,8.019941,1.032152,.0254,
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 GW136,2,14.70639,8.394837,.9380326,13.94473,8.408283,.9665057,.0254,
 GW137,2,13.18228,8.420147,1.001306,13.94473,8.408283,.9665057,.0254,
 GW138,1,13.18228,8.420147,1.001306,12.52345,8.43913,1.033734,.0254,
 GW139,4,11.88755,8.458112,1.06458,12.52345,8.43913,1.033734,.0254,

GW140,3,14.70639,8.560141,.3535418,16.05254,8.229535,.632737,.0254,
GW141,3,17.39869,8.229535,.9119322,16.05254,8.229535,.632737,.0254,
GW142,3,17.39869,8.229535,.9119322,16.05254,8.229535,1.217228,.0254,
GW143,3,14.70639,8.229535,1.521732,16.05254,8.229535,1.217228,.0254,
GW144,3,17.62331,8.229535,1.267847,17.06254,6.929261,1.267847,.0254,
GW145,1,16.50574,8.229535,1.267847,17.00876,8.229535,1.489305,.0254,
GW146,2,18.05436,8.229535,1.949621,17.00876,8.229535,1.489305,.0254,
GW147,1,17.39869,8.229535,.9119322,17.00876,8.229535,1.489305,.0254,
GW148,1,16.73747,8.229535,1.941712,17.00876,8.229535,1.489305,.0254,
GW149,3,17.62331,8.229535,1.267847,17.06808,9.517155,1.267847,.0254,
GW150,2,17.45247,10.42197,1.267847,17.06808,9.517155,1.267847,.0254,
GW151,3,16.50574,8.229535,1.267847,17.06808,9.517155,1.267847,.0254,
GW152,3,16.50574,8.229535,1.267847,17.06254,6.929261,1.267847,.0254,
GW153,2,17.45247,6.037892,1.267847,17.06254,6.929261,1.267847,.0254,
GW154,2,16.67736,6.037892,1.267847,17.06254,6.929261,1.267847,.0254,
GW155,2,10.73122,8.814026,2.182152,10.73122,8.929501,1.1587,.0254,
GW156,6,11.88755,8.458112,1.06458,10.73122,8.929501,1.1587,.0254,
GW157,3,9.575684,9.397726,1.267847,10.73122,8.929501,1.1587,.0254,
GW158,2,10.73122,7.645044,2.182152,10.73122,7.531943,1.175309,.0254,
GW159,3,11.88755,8.000959,1.06458,10.73122,7.531943,1.175309,.0254,
GW160,2,10.73122,7.416468,1.50275,10.73122,7.531943,1.175309,.0254,
GW161,3,9.575684,7.061345,1.267847,10.73122,7.531943,1.175309,.0254,
GW162,2,7.187892,9.397726,1.973885,7.187892,9.397726,1.06458,.0254,
GW163,2,5.867054,9.397726,1.973885,5.867054,9.397726,1.06458,.0254,
GW164,2,7.187892,7.061345,1.973885,7.187892,7.061345,1.06458,.0254,
GW165,2,5.867054,7.061345,1.973885,5.867054,7.061345,1.06458,.0254,
GW166,2,7.187892,7.061345,1.50275,7.187892,7.061345,1.06458,.0254,
GW167,1,5.867054,9.397726,7.600753,5.867054,9.397726,1.06458,.0254,
GW168,1,5.867054,7.061345,7.600753,5.867054,7.061345,1.06458,.0254,
GW169,1,5.867054,7.061345,1.50275,5.867054,7.061345,7.600753,.0254,
GW170,2,7.187892,9.397726,1.50275,7.187892,9.397726,1.06458,.0254,
GW171,1,5.867054,9.397726,1.50275,5.867054,9.397726,7.600753,.0254,
GW172,2,5.409901,7.061345,1.973885,4.838856,7.061345,1.06458,.0254,
GW173,1,4.648244,7.061345,7.600753,4.838856,7.061345,1.06458,.0254,
GW174,1,4.26702,7.061345,1.50275,4.648244,7.061345,7.600753,.0254,
GW175,2,5.409901,9.397726,1.973885,4.838856,9.397726,1.06458,.0254,
GW176,1,4.648244,9.397726,7.600753,4.838856,9.397726,1.06458,.0254,
GW177,1,4.26702,9.397726,1.50275,4.648244,9.397726,7.600753,.0254,
GW178,1,14.70639,8.229535,1.521732,14.70639,8.064233,.9380326,.0254,
GW179,1,14.70639,7.899721,.3535418,14.70639,8.064233,.9380326,.0254,
GW180,1,13.94473,8.229535,1.623761,13.95818,8.051578,.9688785,.0254,
GW181,1,13.94473,7.873621,3.155776,13.95818,8.051578,.9688785,.0254,
GW182,1,13.18228,8.229535,1.724999,13.18228,8.038923,1.001306,.0254,
GW183,1,13.18228,7.848311,2.776133,13.18228,8.038923,1.001306,.0254,
GW184,2,12.53452,8.229535,1.852337,12.54559,8.019941,1.032152,.0254,
GW185,2,12.53452,7.810347,2.135487,12.54559,8.019941,1.032152,.0254,
GW186,1,13.94473,8.229535,1.623761,13.94473,8.408283,.9665057,.0254,
GW187,1,14.70639,8.229535,1.521732,14.70639,8.394837,.9380326,.0254,
GW188,1,14.70639,8.560141,.3535418,14.70639,8.394837,.9380326,.0254,
GW189,1,13.18228,8.61076,2.776133,13.18228,8.420147,1.001306,.0254,
GW190,1,13.18228,8.229535,1.724999,13.18228,8.420147,1.001306,.0254,
GW191,2,12.53452,8.229535,1.852337,12.52345,8.43913,1.033734,.0254,
GW192,2,12.53452,8.648724,2.135487,12.52345,8.43913,1.033734,.0254,
GW193,3,11.88755,8.5724,6.0743,11.88755,8.458112,1.06458,.0254,
GW194,6,11.88755,8.229535,1.973885,11.88755,8.458112,1.06458,.0254,
GW195,2,11.88755,8.229535,1.973885,11.88755,8.000959,1.06458,.0254,
GW196,2,11.88755,7.772383,1.50275,11.88755,8.000959,1.06458,.0254,
GW197,4,10.73122,8.229535,1.50275,11.88755,8.229535,1.50275,.0254,
GW198,2,9.575684,8.229535,1.50275,10.73122,8.229535,1.50275,.0254,
GW199,2,8.382183,8.229535,1.50275,9.575684,8.229535,1.50275,.0254,
GW200,2,7.187892,8.229535,1.50275,8.382183,8.229535,1.50275,.0254,
GW201,2,10.73122,8.98605,6.54488,10.73122,8.929501,1.1587,.0254,
GW202,2,8.978538,9.397726,1.973885,8.978538,9.397726,1.06458,.0254,
GW203,2,9.575684,9.397726,2.385418,9.575684,9.397726,1.267847,.0254,
GW204,2,8.978538,9.397726,1.50275,8.978538,9.397726,1.06458,.0254,
GW205,1,8.382183,9.397726,1.50275,8.978538,9.397726,1.50275,.0254,
GW206,2,9.575684,9.397726,1.50275,10.73122,9.042603,1.50275,.0254,
GW207,2,9.575684,9.397726,1.50275,9.575684,9.397726,1.267847,.0254,
GW208,2,9.575684,7.061345,2.385418,9.575684,7.061345,1.267847,.0254,
GW209,2,9.575684,7.061345,1.50275,9.575684,7.061345,1.267847,.0254,
GW210,3,9.575684,9.397726,2.385418,10.73122,8.814026,2.182152,.0254,
GW211,3,9.575684,7.061345,2.385418,10.73122,7.645044,2.182152,.0254,

GW212,3,11.88755,8.229535,1.978885,10.73122,7.645044,2.182152,.0254,
 GW213,3,11.88755,8.229535,1.978885,10.73122,8.814026,2.182152,.0254,
 GW214,2,8.978538,7.061345,1.978885,8.978538,7.061345,1.06458,.0254,
 GW215,2,8.978538,7.061345,.150275,8.978538,7.061345,1.06458,.0254,
 GW216,2,11.88755,7.772383,.150275,10.73122,7.416468,.150275,.0254,
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 GW218,2,9.575684,8.229535,2.385418,10.73122,8.229535,2.182152,.0254,
 GW219,2,10.73122,9.042603,.150275,11.68032,8.750752,.150275,.0254,
 GW220,2,11.88755,8.5724,.60743,11.88755,8.686688,.150275,.0254
 GW221,2,10.73122,8.98605,.654488,10.73122,9.042603,.150275,.0254
 GW222,3,11.88755,8.5724,.60743,11.3094,8.77923,.630959,.0254
 GW223,3,11.3094,8.77923,.630959,10.73122,8.98605,.654488,.0254
 *****GM 0,0,0,180 (MOVE UP 2 GND) (ROTATE ABOUT Z AXIS)
 *****GE (GEI FOR GROUND *** AND ADD GN AND GM CARDS)
 *****FR 0,0,0,26.836,0

WG

*****ORIGINAL LONGWIRE ANTENNA*****

NX

CM ORIGINAL LONGWIRE ANTENNA SPACED 18" FROM A/C

CM STANDARD RADIATION PATTERNS

CE

GF

GW401,1,11.88755,8.458112,1.064580,11.88755,8.908386,1.064580,.0254 ANT
 GW402,8,11.88755,8.908386,1.064580,10.73122,9.41774,.8175375,.0254 ANT
 GW403,4,10.73122,9.41774,.8175375,10.73122,9.324411,1.651959,.0254 ANT
 GW404,8,10.73122,9.324411,1.651959,12.53452,8.62981,1.852062,.0254 ANT
 GW405,14,12.53452,8.62981,1.852062,16.05254,8.62981,1.216953,.0254 ANT
 GM 0,0,0,0,180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)

GE

EX 0,402,2,01, 1,0 (1 VOLT EXCITATION, ANT = 402,2)

PL3, 2, 0, 4

RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT

PL3, 2, 0, 4

RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG

PL3, 1, 0, 4

RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT

PL3, 1, 0, 4

RP0, 361, 1, 1000, 0, 45, 1, 0 VERT CUT AT PHI = 45 DEG

XQ

*****COLLINS 437R-2 ANTENNA*****

NX

CM ESTIMATED ORIGINAL PLACEMENT OF 437R-2 ANT

CM STANDARD RADIATION PATTERNS

CE

GF

GW401,3,11.3094,8.77923,.630959,11.3094,8.901028,0,.0254 ANT
 GW402,8,11.88755,8.529294,1.978885,11.88043,8.901028,0,.0254 ANT
 GW403,16,11.88755,8.529294,1.978885,16.05254,8.529294,1.217228,.0254 ANT
 GW404,2,11.3094,8.901028,0,.11.88043,8.901028,0,.0254 ANT
 GM 0,0,0,0,180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)

GE

EX 0,401,2,01, 1,0 (1 VOLT EXCITATION, ANT = 401,2)

PL3, 2, 0, 4

RP0, 1, 361, 1000, 90, 0, 0, 1 STD. HORIZONTAL PATTERN CUT

PL3, 2, 0, 4

RP0, 1, 361, 1000, 26, 0, 0, 1 HORIZONTAL CUT, ELEVATION = 64 DEG

PL3, 1, 0, 4

RP0, 361, 1, 1000, 0, 0, 1, 0 STD. VERTICAL PATTERN CUT

PL3, 1, 0, 4

RP0, 361, 1, 1000, 0, 45, 1, 0 VERT CUT AT PHI = 45 DEG

XQ

*****PROPOSED CG COLLINS 437R-2 ANT INSTALLATION*****

NX

CM PROPOSED CG LOCATION OF COLLINS 437R-2 ANT

CM STANDARD RADIATION PATTERNS

CE

GF

GW401,3,11.3094,8.77923,.630959,11.31,9.3,.63,.0254
 GW402,20,11.31,9.3,.63,16.0,8.5,0.3,.0254
 GM 0,0,0,0,180 (ROTATE ABOUT Z AXIS TO HEAD IN PHI=0)

GE

EX 0,401,2,01, 1,0 (1 VOLT EXCITATION, ANT = 401,2)

FILE: H60 DATA A1

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PL3, 2, 0, 4
RP0, 1, 361, 1000, 90, 0, 0, 1     STD. HORIZONTAL PATTERN CUT
PL3, 2, 0, 4
RP0, 1, 361, 1000, 26, 0, 0, 1     HORIZONTAL CUT, ELEVATION = 64 DEG
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 0, 1, 0     STD. VERTICAL PATTERN CUT
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 45, 1, 0     VERT CUT AT PHI = 45 DEG
XQ
*****ARMY-TYPE TUBE ANTENNA*****
NX
CM TUBE ANTENNA
CM STANDARD RADIATION PATTERNS
CE
GF
GW401,1,11.88755,8.458112,1.064580,11.88755,8.686688,1.064580,.0254     ANT
GW402,1,16.05254,8.229535,.9119322,16.05254,8.458112,.9119322,.0254     ANT
GW403,12,11.88755,8.686688,1.064580,14.70639,8.623414,.9377575,.0254     ANT
GW404,12,14.70639,8.623414,.9377575,16.05254,8.458112,.9119322,.0254     ANT
GM 0,0,0,0,180                     (RCTATE ABOUT Z AXIS TO HEAD IN PHI=0)
GE
EX 0,403,2,01, 1,0                     (1 VOLT EXCITATION, ANT = 403,2)
PL3, 2, 0, 4
RP0, 1, 361, 1000, 90, 0, 0, 1     STD. HORIZONTAL PATTERN CUT
PL3, 2, 0, 4
RP0, 1, 361, 1000, 26, 0, 0, 1     HORIZONTAL CUT, ELEVATION = 64 DEG
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 0, 1, 0     STD. VERTICAL PATTERN CUT
PL3, 1, 0, 4
RP0, 361, 1, 1000, 0, 45, 1, 0     VERT CUT AT PHI = 45 DEG
XQ
EN

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